

## Revision of Palaearctic *Piesmatidae*

(*Heteroptera*)

Von Ernst HEISS and Jean PÉRICART

### Zusammenfassung

Die Autoren haben auf der Basis des Typenmaterials die paläarktischen Arten der Gattung *Piesma* (*Heteroptera*, *Piesmatidae*) revidiert. Die Arbeit gibt eine Synthese der bisherigen Kenntnisse über die Gattung und umfaßt im ersten Teil die Abschnitte: Geschichtlicher Überblick, Morphologie und Physiologie der Imagines, Entwicklungsstadien, Ethologie und Ökologie sowie Phyletischer Ursprung der *Piesmatidae*. Der zweite Teil umfaßt eine systematische Revision aller paläarktischen Arten und Bestimmungstabellen für Imagines und die bekannten Larvalstände. *P. kerzhneri* n. sp. aus der Mongolei wird beschrieben und *P. longicarinum* HSIAO et JING als Subspezies zu *P. kochiae* gestellt. Ein Verzeichnis der bekannten Fraßpflanzen und die umfangreiche Literatur werden angeführt.

### Abstract

On the basis of the type material, the authors have revised the Palaearctic species of the genus *Piesma* (*Heteroptera*, *Piesmatidae*). The present paper gives a synthesis of the hitherto existing knowledge on this genus and comprises in its first part the following chapters: Historical Review, Adult Morphology and Physiology, Immature Stages and Development, Ethology and Ecology, and Phyletic Origin of the *Piesmatidae*. The second part includes a systematic revision of all Palaearctic species and gives keys for adults and the known nymphs. *P. kerzhneri* n. sp. from Mongolia is described and *P. longicarinum* HSIAO et JING proposed as a subspecies of *P. kochiae*. A list of the known host plants is given and the rich literature is cited.

### Sommaire

Les auteurs ont révisé les espèces paléarctiques du genre *Piesma* (*Heteroptera*, *Piesmatidae*) sur la base du matériel-type disponible. La présente publication apporte une synthèse des connaissances acquises aujourd'hui sur ce genre. La première partie contient les chapitres suivants: Historique; Morphologie et physiologie des adultes; Premiers états et développement; Ethologie et écologie; Origines phylétiques des *Piesmatidae*. La seconde partie renferme la Révision systématique de toutes les espèces paléarctiques et les tableaux d'identification des adultes et des larves connues. Une nouvelle espèce, *Piesma kerzhneri* n. sp., est décrite de Mongolie; *P. longicarinum* HSIAO et JING est considéré comme sous-espèce de *P. kochiae*. Un index des plantes-hôtes connues et une importante bibliographie sont donnés.

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## Preface

It is a great pleasure for me to preface this paper, which not only serves to considerably improve our knowledge of an interesting and taxonomically difficult group of Palaearctic *Heteroptera*, but also represents a modern monograph which I believe may be taken as a guideline by other entomologists.

This paper is of further interest as it is a result of international scientific cooperation. Ernst HEISS of Innsbruck, Austria, and Jean PÉRICART of Montereau, France, engineers by profession, have both been interested in insects from youth and initially started with the study of *Coleoptera*, where they published several papers. Later, both chose the *Heteroptera* and became estimated specialists of this insect group. The most important papers of HEISS concern *Aradidae* of all zoogeographic regions, those of PÉRICART *Anthocoridae*, *Microphysidae*, *Cimicidae* as well as *Berytidae* and *Tingidae* of Western Palaearctics. The publications of both authors are characterized by the highest standard of accuracy, completeness and professional attitude, always based on personal studies of the type material and the collections of the most important museums, in connection with excellent figures, maps and exact chorological references.

Both authors are also actively involved in entomological activities as they are members of several entomological societies. Mr. HEISS is founder member of the Austrian Entomological Society and Mr. PÉRICART has been president of the French Entomological Society. Individuals of such corresponding interests, enthusiasm and working methods, Ernst HEISS and Jean PÉRICART became close friends years ago and published as early as 1975 a preliminary paper to the present revision, which is also a mutual effort.

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## Introduction

The small phytophagous family of *Piesmatidae*, which comprises less than forty species known to date, is represented in the Palearctic realm by only 15 species, all belonging to the main genus *Piesma*.

Due to a striking convergence, these insects show almost exactly the habitus of *Tingidae*, which led ancient authors to classify them first within, later next to this family, a position which authors followed until recently. In reality, the *Piesmatidae* are phylogenetically very distant from *Tingidae* and are now considered as a very old, distinct superfamily, the *Piesmatoidea*, which is unique in various respects. This fact has stimulated particular scientific interest to study the morphology, physiology and systematics of this small group. In addition, it is of economic interest as at least two species of the genus *Piesma* are transmitters of a serious virus disease affecting sugar and fodder beet.

The last revision of palaeartic *Piesma*, treating only the adults, was given by the Hungarian hemipterologist HORVÁTH in 1906. Since then, the number of described species has only slightly increased, but the knowledge of alary polymorphism, preimaginal stages, ecology and chorology of the species has been considerably improved. These reasons justify a publication giving a synthesis of the accumulated knowledge and allowing the identification of species, which is still difficult.

The revision presented herewith comprises two parts. In the first part, general considerations concerning history, morphology of the adults, eggs and immature stages, ecology and phylogeny are given. The second part deals with systematics, including keys for the determination of adults and last nymphal instars as far as they are known, further a list of synonymies for each species, the localization of type specimens, a brief description of the adult and as far as possible of the immature stages, information available on the life cycle of these insects, and finally, very detailed data on their chorology. Figures and diagrams facilitate the identification, and geographic maps show the distribution. On the maps, each locality is marked with small solid black triangles, circles or squares (▲ ● ■) when the concerned material has been checked by one of the authors, or else white (△ ○ □) if the information could not be directly verified; the dotted area indicates a more or less continuous distribution where, in any case, the exact origin of the references, checked or not checked, is given in the text: name of the collector, the museum where the specimen has been seen, bibliographical data, etc.

The revision includes a rich bibliography. Finally, a list of abbreviations used for all cited museums and institutions, an entomological index in alphabetical order and an index of host plants are given.

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We are particularly grateful to I. M. KERZHNER, who made available for our studies the rich and important material from European and Asian parts of USSR in the collection of the Zoological Institute of the Academy of Sciences in Leningrad.

## First Part: General

### I. Historical Review

As the identity of *Acanthia clavicornis* in the sense of FABRICIUS (1775) is uncertain, it appears that the first description of a *Piesmatidae* species comes from WOLFF (1804) under the name of *Acanthia capitata*. The generic name *Piesma* was created in 1828 by LE PELETIER and SERVILE and its synonym *Zosmenus* by LAPORTE DE CASTELNAU in 1833. In 1844 FIEBER recorded six European species under the latter name, but only four of these species are really distinct.

The *Piesma* or *Zosmenus* were treated as *Tingidae* by almost all nineteenth-century hemipterologists, first as a simple genus, then following STÅL (1874) as representatives of an own subfamily. But some ancient authors, considering the particular morphology of these insects, placed them in the *Lygaeidae*; such as SPINOLA (1837), HERRICH-SCHAEFFER (1853), FLOR (1860) and SNELLEN VAN VOLLENHOVEN (1870).

REUTER (1910, 1912) classified this small group of *Heteroptera* as a distinct family, the „*Piesmidae*“, while keeping it close to the *Tingidae*. This point of view was followed by STICHEL (1926), GULDE (1938) and KIRITSHENKO (1951).

Proceeding from arguments which will be developed further, SOUTHWOOD (1956 a) and SCUDDER (1959) again associated the *Piesmatidae* with the *Lygaeoidea*, a standpoint which was also taken up by STICHEL (1957).

The name „*Piesmatidae*“ already used by STICHEL (1926) and HOBERLANDT (1942) in place of „*Piesmidae*“ was etymologically justified by DRAKE & DAVIS (1958). This name is being used in most recent works.

The most important recent contribution to the study of systematics of *Piesmatidae* is the above-mentioned publication by DRAKE & DAVIS, since it provides very interesting elements on the adult morphology and establishes the generic divisions on a world-wide scale.

The genus *Piesma* was recently divided into three subgenera (PÉRICART, 1974) with its West Palaearctic representatives being the subject of a study resulting in diverse synonymies and various regroupings and notably in the reestablishment of the status of *Piesma quadratum* FIEBER, needlessly complicated in several publications by E. WAGNER (HEISS & PÉRICART, 1975).

The preimaginal forms, at least for the older stages, are known to us for most of the European species. The eggs and young nymphs, notably of *Piesma quadratum*, were described (WILLE, 1929); for *Piesma maculatum*, we refer to the work of LEE & PARK (1971) and for the Russian species to that of PUTSHKOV (1974).

From an ecological point of view, *Piesma quadratum* in Europe and *P. cinereum* in North America have benefited from the extensive studies performed up until recent years concerning their role as transmitters of virus diseases affecting sugar and fodder beet.

### II. Adult Morphology and Physiology

The first sufficiently complete description of the morphology of a *Piesma* is found in the already cited publication by WILLE on *Piesma quadratum*, but the most comprehensive work published to date is that by DRAKE & DAVIS (l. c.) on the *Piesmatidae*, i. e. on the three presently known genera *Piesma*, *Miespa*, and *Mcateella*. It is from this publica-

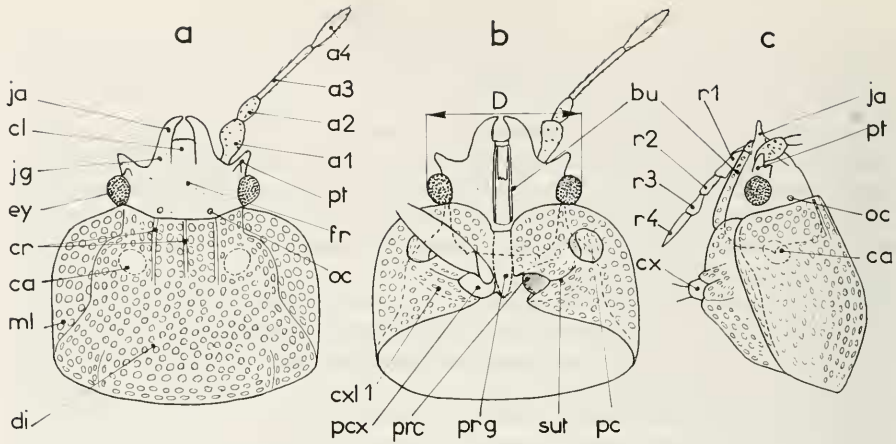


Fig. 1: Morphology of head and prothorax of *Piesma quadratum*. – a, dorsal view; b, ventral view; c, lateral view. – a1–a4 = antennal segments; bu = bucculae; ca: callosities; cl = clypeus; cr = carinae; cx = coxa; cxl 1 = procoxal lobe; D = diatone; di = disc of pronotum; ey = eye; fr = frons; ja = jugal appendices; jg = juga; ml = marginal laminae (paranota); oc = ocelli; pc = propleural cavity; pcx = procoxa; prc = procoxal cavity; prg = prosternal rostral groove; pt = preocular tubercles; r1–r4 = rostral segments; sut = suture. – (Original).

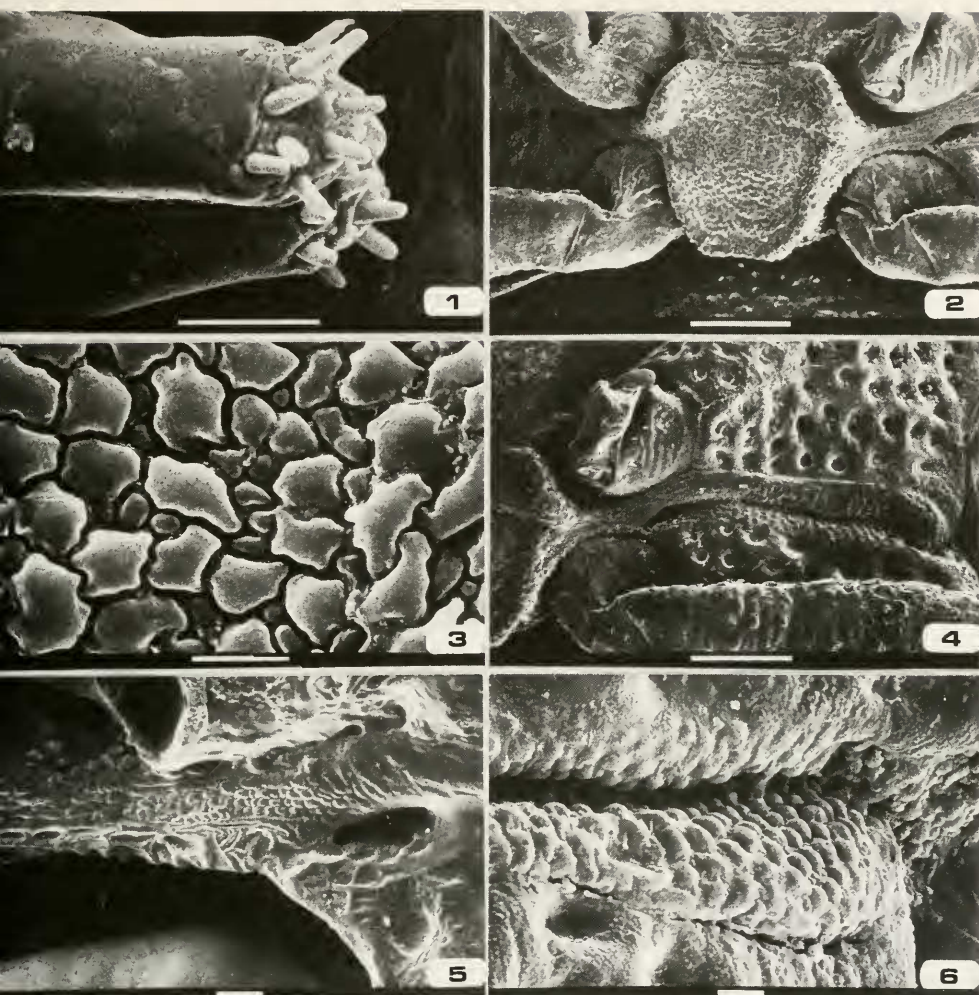
tion that the major portion of the morphological elements given below are taken. The authors also took into consideration various studies on the stridulatory apparatus, and on the odoriferous and reproductive organs, which will be cited later.

The *Piesma* are small *Heteroptera*, being 1.5 mm to 4 mm in size. Their coloration is mostly brownish gray, greenish gray, stramineous or brownish on top, sometimes with black stripes or spots or with the pronotum partially black. Their general habitus is very similar to that of the *Tingidae*, having as a common character aerolate teguments on the pronotum, the hemelytra and other parts of the body.

#### Head (figs. 1 a, b, c, photo 1):

The head is relatively wide and short and is inserted into the prothorax up to the posterior border of the eyes. It is prognathous with strongly convex eyes. Ocelli are present in macropterous forms, but poorly developed and hardly visible in brachypterous ones. From above, the juga are clearly visible on both sides of the clypeus, more or less protruding beyond it, forming the **jugal appendices**, of which length and shape are characteristic on species level and are subject to considerable sexual dimorphism; for the keys and descriptions given in this paper, this term is abbreviated into “juga”. The **bucculae** are relatively large, areolate, not fused at the front, but forming the rostral channel which is open anteriorly. The short antennae are four-segmented, the first segment is short and thick, the second long and subcylindrical, the third is thin, cylindrical and generally the longest, while the last is fusiform. The surface of the first three segments and especially of the first one is densely covered with microtubercles. The antennal insertion is lateral and at a level slightly lower than the lower margin of the eyes. Between the eye and the antennal insertion there is a **preocular tubercle**. These tubercles are simple and conical (subgenus





Photos 1-6: Rostrum and thorax of *Piesma kerzhneri* n. sp. (Paratype). 1, tip of rostral segment IV; 2, metasternum; 3, microsculpture of the metasternum; 4-6, metathoracic scent gland opening and channel like structures. Scale: 2,4 = 100 microns; 1, 3, 5, 6 = 10 microns.

*Piesma* and *Afropiesma*) or double, consisting of a posterior cone and an anterior cone which is usually larger, both cones being well visible from above and in profile (subgenus *Parapiesma*). The rostrum is relatively short and four-segmented; the apex of the fourth segment (photo 1) is not trilobate (absence of apical plate sensu COBBEN 1978). The accessory salivary glands are tubular (*Pentatomorpha*-type) and the principal glands trilobate.

Thorax (figs. 1a, b, c, 3a, b, photos 2-6):

The pronotum, almost entirely and densely areolate, is subrectangular, with convex disc, raised posteriorly. Its lateral margins are expanded to **marginal laminae**<sup>1</sup> as in the *Tingidae*. The disc has two median carinae in its anterior region (*Piesma* s. str. and *Afro-piesma*), or three or five carinae visible at least in the center (subgenus *Parapiesma*) and two smooth callosities in the front on both sides of these. The scutellum is rather small and triangular.

The prosternum, almost entirely areolate, has two coxal lobes covering the base of the anterior coxae. The coxal cavities are open posteriorly and separated by the narrow rostral groove. The coxal lobes are divided by a ventrodorsally directed suture, the vestige of a separation between the episternal and epimeral regions. Near the end of this suture on the dorsal side there is a tegumentary invagination. These structures form the **propleural cavities**, a particular morphological feature only known in *Piesmatidae*.

The mesothorax and the metathorax are not clearly separated on the ventral side. Their pleural regions, also mostly areolate, have mesocoxal and metacoxal lobes covering the base of their respective intermediate and posterior coxa. The mesocoxal lobes are divided

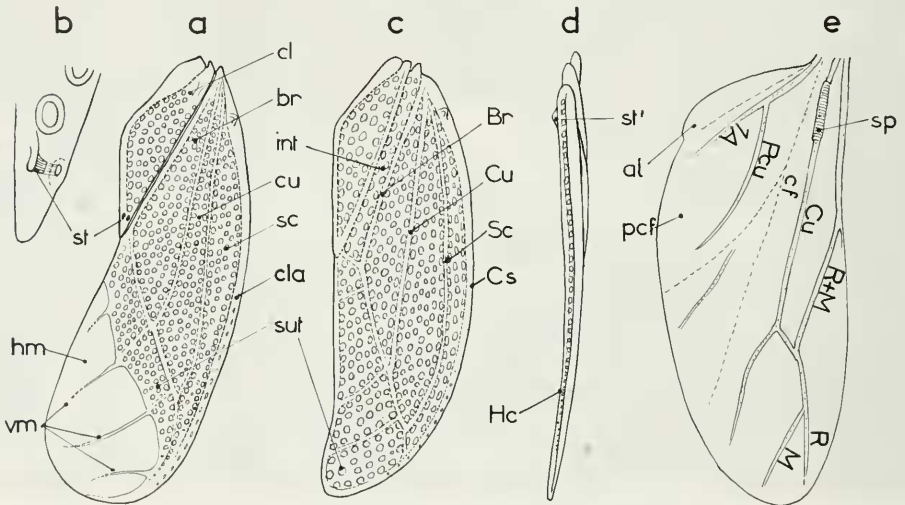


Fig. 2: Hemelytra and hind wing of *Piesma quadratum*. — a, hemelytra of a macropterous specimen; b, id., apical part of clavus ventral (see photos 7, 8); c, hemelytra of a brachypterous specimen; d, id., lateral view; e, hind wing of a macropterous specimen. — al = anal lobe; Br = brachial vein; br = brachial area; cf = cubital fold; cl = clavus; cla = costal lamina; Cs = costal vein; Cu = cubital vein; cu = cubital area; Hc = hypocostal vein; hm = hyaline part of membrane; int = interstitial area; M = medial vein; pcf = post cubital field; Pcu = post cubital vein; R = radial vein; Sc = subcostal vein; sc = subcostal area; sp = stridulatory part of the cubital vein; st, st' = protruding structures; sut = sutural area (areolate part of membrane); vm = veins of membrane; 1A = vein of anal part. — (Original).

1 The authors avoid the terms **paranota** or **paranotal laminae** generally used to designate these regions, but which are incorrect.



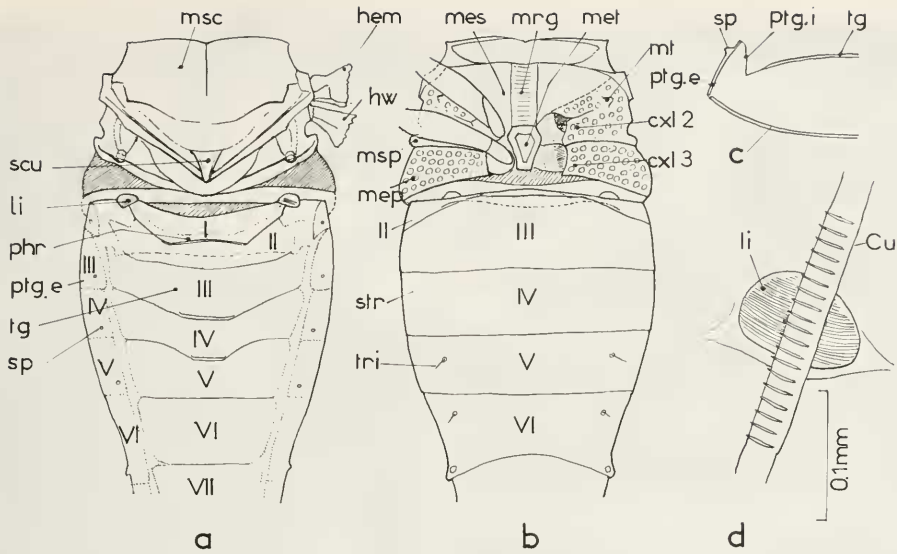
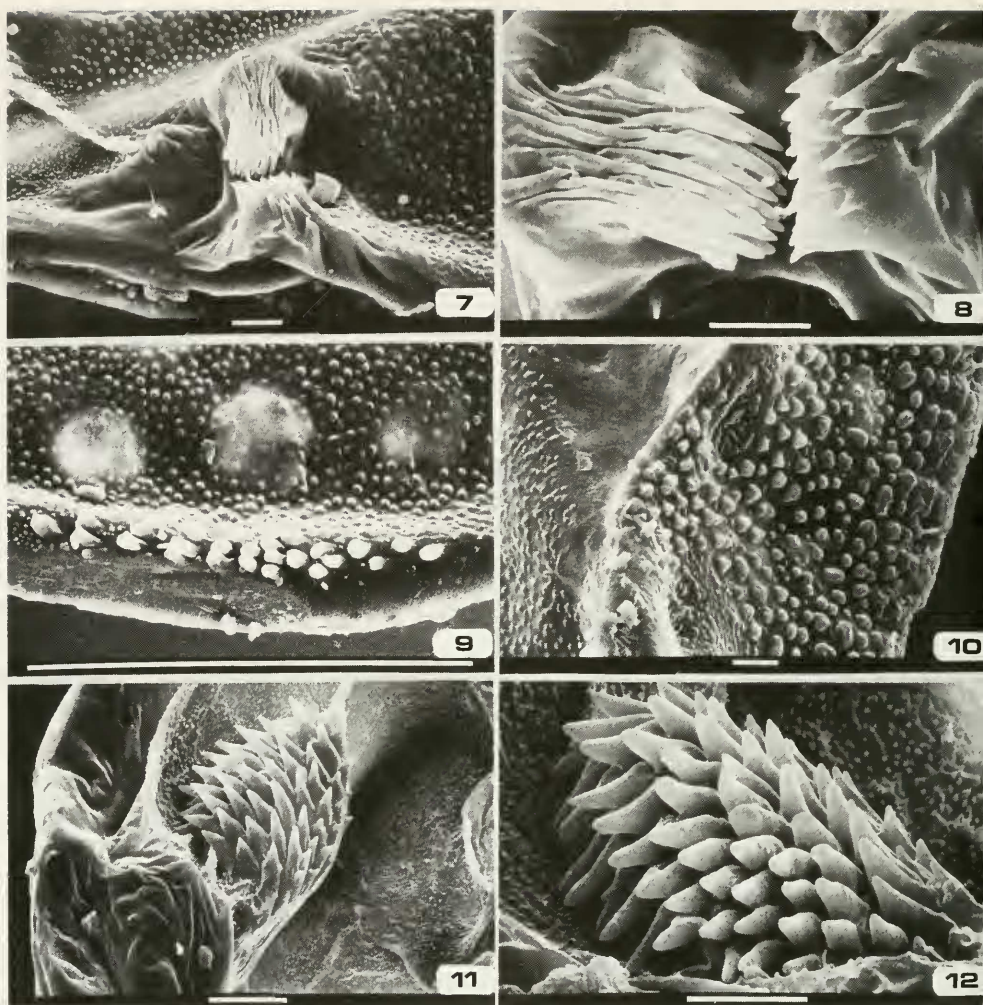


Fig. 3: a-c, Pterothorax and abdomen of *Piesma quadratum*; a, dorsal view, hemelytra and hind wings removed (left side) or cut (right side); b, ventral view; c, section of abdomen at tergite IV; d, stridulatory apparatus of *P. maculatum* (right side). - Cu = cubital vein; cxl 2, cxl 3 = coxal lobes; hem = hemelytra; hw = hind wing; li = lima; mes = metasternum; mep = mesopleura; mrg = mesosternal rostral groove; msc = mesoscutum; mt = mesosternal tubercle; msp = mesopleura; phr = phragma; ptge = external paratergites; ptgi = internal paratergites; scu = scutellum; sp = spiracles; str = sternites; tg = tergites; tri = trichobothria; I-VII = abdominal urites. - (Original).

by a ventrodorsally directed suture having the same anatomical significance as those of the procoxal lobes. The mesopleura bear a small process or tubercle at the distal end of this suture. The mesosternum is longitudinally depressed along its median region with transverse carinae (rostral groove).

The metasternum, which follows this region posteriorly, is a more or less hexagonal plate whose shape can provide specific characters. CARAYON (1962) pointed out the remarkable development of metathoracic scent glands of *Piesma* and their opening into a small orifice situated at the middle of the inner border of metacoxal cavities, at the base of the metasternal apophyses. He noted the apparent absence of odorific channel and evaporation area.

Our investigations on *Piesma kerzhneri* n. sp. show that the channel does exist, although tenuous; SEM photos 4 and 6 show a well visible channel extending laterally from the metathoracic gland opening. Nevertheless the mushroom-like microsculpture, characteristic of what is considered to date as evaporation area in many families of *Heteroptera* does not appear here. Neither the irregular microsculpture on the slopes of the channel (photo 6) or on the metasternum (photos 2, 3, 5), nor the punctuation on the metapleura (photo 4) are comparable to such surfaces. The interpretation of these photos has been discussed with Prof. CARAYON; the authors thank for his comments.



Photos 7–12: Cuticular structures on hemelytra and hind wings of *Piesma kerzhneri* n. sp. (Paratype). 7, 8, apex of clavus, ventral; 9, suture of clavus, ventral; 10, basis of costal lamina, ventral; 11, 12, basis of hind wing, ventral. Scale: 9 = 100 microns; 7, 8, 10–12 = 10 microns.

#### Hemelytra (figs. 2a, b, c, d, photos 7–10):

The *Piesma* are subject to wing polymorphism, having macropterous, brachypterous and intermediate forms. In all cases the hemelytra completely cover the abdomen; their exterior margin is inflected ventrally forming the narrow **hypocostal lamina** which curves in under the lateral edges of the abdomen. In the macropterous forms the clavus is well delimited by a commissure, the corium is divided into several areas separated by carinae or veins whose homologies with the primitive venation have not been established with

certitude. From the exterior to the interior one first distinguishes the **costal laminae**, which are narrow and which hide the hypocostal laminae when the insect is seen from above, then the **subcostal**, **cubital** and **brachial** areas.<sup>2</sup> An oblique transverse ridge delimitates the membrane, whose basal section, areolate as the corium, constitutes the **sutural area**. The distal section of the membrane is hyaline and lacks areolae. The membrane has four to five longitudinal veins whose homologies with the primitive venation are equally uncertain.

As SEM photos reveal, the ventral side bears some peculiar cuticular structures e. g. at the apex of the clavus (photos 7, 8) and along its suture (photo 9), as well as at the basis of the costal lamina (photo 10), presumably all related to folding and keeping the position at rest of the hind wings.

From the stage of complete development on, the reduction of the hemelytra affects the membrane and the delimitation of the various areas. In order to have a precise vocabulary to describe the species, the authors proposed the following definitions, which are necessarily somewhat arbitrary (HEISS & PÉRICART, 1975).<sup>3</sup>

– Macropterous forms:

Completely developed hemelytra, clearly surpassing the apex of the abdomen even in the females; clavus, corium and membrane distinct.

– Submacropterous forms:

Hemelytra not or only slightly surpassing the abdomen, but clavus, corium and membrane distinct; the hyaline section of the membrane is considerably reduced but with visible veins.

– Subbrachypterous forms:

Hyaline section of the membrane strongly reduced, sometimes limited to a simple hem, suture of the clavus existing only toward the base or even completely absent; an areolate area or **interstitial area** is formed by the fused external row of areolae of the clavus and the contiguous internal row of the corium.

– Brachypterous forms:

Hemelytra areolate over the entire surface, membrane and clavus generally not delimited.

### **Hind wings** (fig. 2e, photos 11, 12):

The terminology used to designate the veins and folds conforms to that proposed by LESTON (1953) which was adopted by DRAKE & DAVIS (l. c.). The subcostal vein (Sc) is absent; a small branch or hamus may be present near the basal quarter of the cubital veins; in the male the latter is distinctly thickened at its base, forming part of the stridulatory apparatus which will be described later. The cubital furrow is bifurcated and the postcubital area very extended. The anal lobe is relatively narrow.

The hind wing is affected by the brachypterism and can disappear almost completely with the exception of the part of the Cu vein modified by the stridulatory apparatus in the male.

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2 The authors employ the terminology in current use without discussing whether it is well founded.

3 In this publication only the hyaline portion of the membrane was considered as being part of this area.

Legs (figs. 4 a, b, c, photos 13–17):

The coxae are clearly of the “rotatory” type. The legs haven’t any spines and teeth, however the femora and tibiae are densely granulated (microtubercles) each granule bearing a short bristle. The femora are only slightly swollen; tarsi biarticulated; claws with blunt apices, setiform parempodia and pseudopulvilli<sup>4</sup> of a complicated structure, arising from the unguitactor plate, are present and seem not to differ principally within the genus.

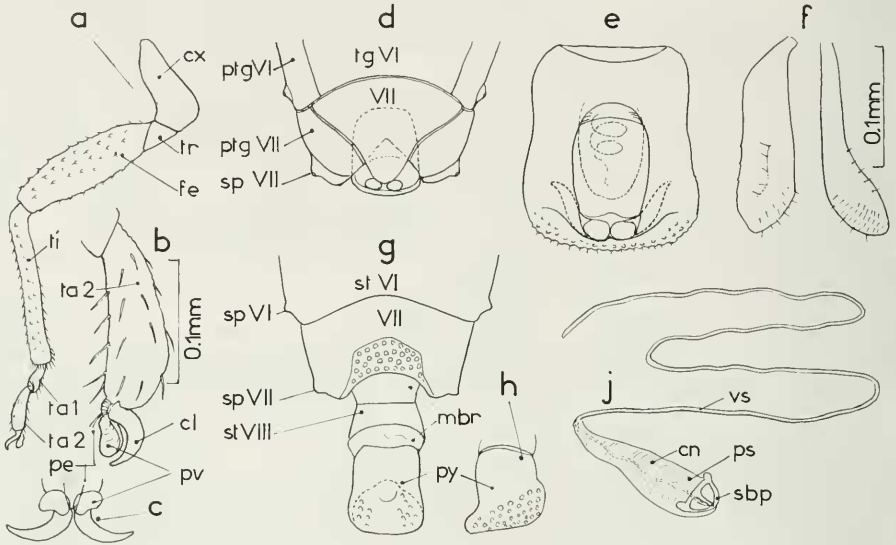


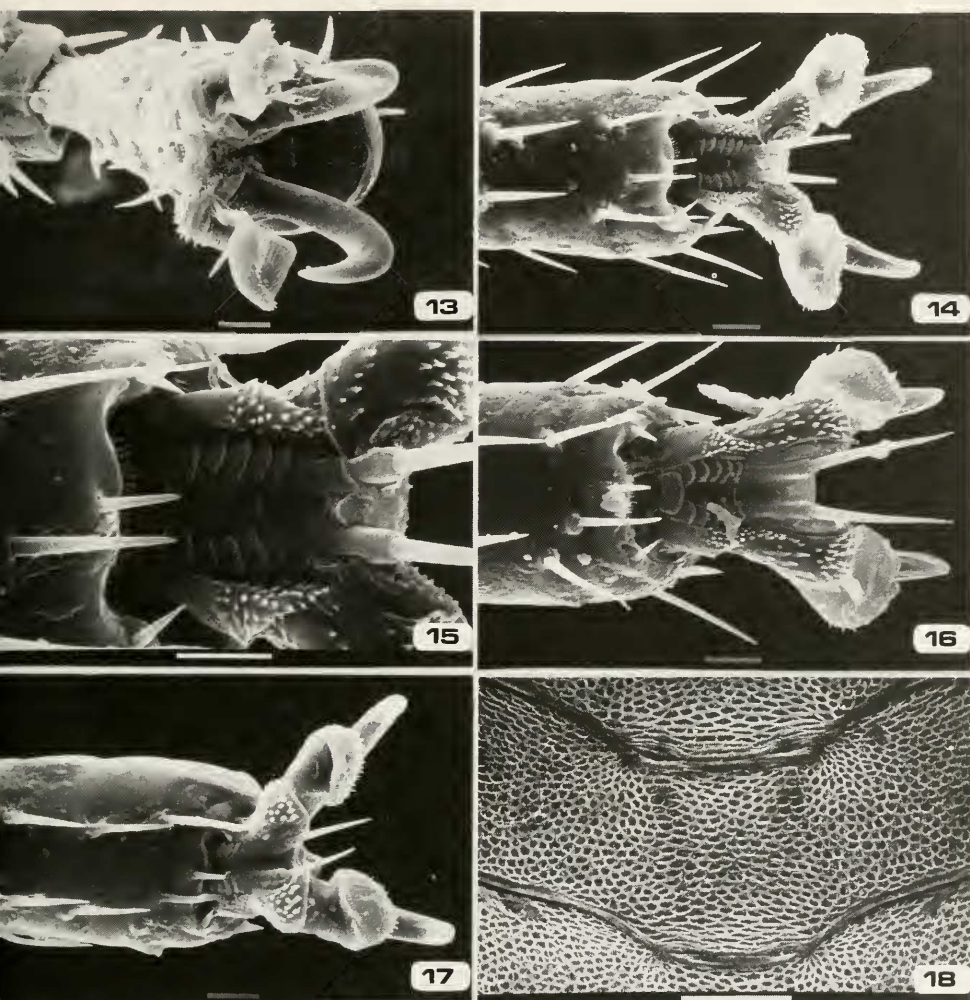
Fig. 4: a, Right fore leg of *Piesma maculatum*; b, id., last tarsal segment and claws; c, claws, ventral view; d, genital urites of *P. maculatum* ♂, dorsal view; e, pygophore, dorsal view; f, left paramere of *P. quadratum*, dorsal and lateral view; g, genital segments of *P. maculatum* ♂, ventral view, pygophore extricated; h, pygophore, lateral view; j, phallus of *P. cinereum*. –cl = claws; cn = conjunctiva; cx = coxa; fe = femur; mbr = intersegmental membranes; pe = parempodia; ps = phallosoma; ptg = paratergites; pv = pseudopulvilli; py = pygophore; sbp = stirrup shaped basal plate of phallus; sp = spiracle; st = sternite; ta 1, ta 2 = tarsal segments; tg = tergites; ti = tibia; tr = trochanter; vs = vesica; VI–VIII = number of tergites. – (a–h): Originals; j, after DRAKE & DAVIS, 1958).

**Pregenital segments of the abdomen (figs. 3 a, b, photos 18–20):**

Tergite I is visible on the dorsal side and is found partially modified in the male, forming part of the stridulatory apparatus. In both sexes tergites I and II are fused, however there is an intersegmentary membrane between II and III. Tergites III to VII are fused. All these sutures remain easily visible especially in cleared specimens. The odoriferous orifices of the nymphal dorso-abdominal glands are in the middle of sutures III–IV and IV–V; they are not functional in adults (photo 18).

<sup>4</sup> The authors here use the terminology for the pretarsal structures as introduced first by COBBEN (1968) and further developed by SCHUH (1976).

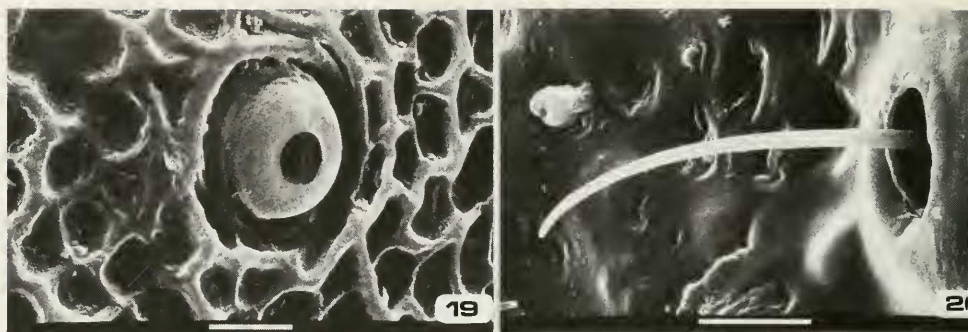




Photos 13–18: Pretarsal structures and tergites III–V of *Piesma*. 13–15, *P. salsolae* (Italy); 16, *P. quadratum* (Austria); 17, *P. capitatum* (Austria); 18, medial part of tergites III–V of *P. kerzhneri* n. sp. (Paratype). Scale: 18–100 microns; 13–17 = 10 microns.

Tergites II to VI each have a dorsal plate, a large portion of which is sclerotized, one pair of membranous internal paratergites and one pair of sclerotized external paratergites. The internal paratergites oriented in the sagittal plane, or even sloping, are difficult to see from above. Contrarily, the external paratergites, directed laterally, are clearly visible. Their angular connection to the internal paratergites forms the dorsal part of the connexivum. The dorsoventral suture is situated at the external margin of the external paratergite.

On the ventral side sternite I is absent and sternite II is reduced to two lateral sclerites and to a membranous median zone forming a flexible thoraco-abdominal junction. Ster-



Photos 19–20: Abdominal structures of *Piesma kerzhneri* n. sp. (Paratype). 19, trichobothrium at sternite V; 20, spiracle on external paratergite III. Scale: 10 microns.

nites III and IV are fused, and the connections between IV and V and the following are made by short but visible intersegmental membranes, which allow the abdomen to curve slightly back toward the bottom. Sternites V and VI have a small cavity on each side from which a long trichobothrium emerges (photo 19).

Spiracles II to V are located dorsally (photo 20), as it is common among the *Coreiidae* and *Lygaeidae*, on the external paratergites. Spiracles VI are found in the ventral area very close to the dorsoventral sulcus and are visible from above on the lateral margin, where they are located at the tip of a small tubercle. The same position have spiracles VII. There are no visible spiracles on urite VIII. In fact, it is probable that at the level of urites VII and VIII and in relation to the disappearance of the connexivum, the external paratergite with the stigma, is in the ventral position, while the internal paratergite becomes sclerotized and takes the place of the external paratergite. An analogous displacement was noted by Šrýs (1967) in the *Berytidae* in a situation which was actually a bit different.

#### Male genital segments (figs. 4d, e, f, g, h, j, photos 27–30):

These are entirely symmetrical. Urite VIII is ring-shaped and when at rest is completely invaginated, just as urite IX (pygophore), in segment VII. On the dorsal side, the median part of tergite VII extends posteriorly and partially covers the tip of the pygophore. As in many *Heteroptera*, the latter has the form of a convex capsule in its ventrodistal part and is flattened on top. On the dorsal side is the proctiger, which is entirely membranous. The shape of the parameres is simple and does not vary considerably; at rest they fold back beneath the posterior margin of the pygophore, their apices not touching each other, the convex side of their “blade” being turned toward the lateral margin of the capsule.

As in most of the *Heteroptera*, the phallus is lying in the pygophore and comprises a sclerotized stirrup-shaped basal plate traversed by the ejaculatory duct. The phallus is differentiated into phallosoma, conjunctiva and vesica. The phallosoma is a simple, slightly sclerotized tube in which the conjunctiva and part of the vesica invaginate when at rest. In the phallosoma there is a small sclerotized thickening of the seminal duct, which is the ejaculatory reservoir. The conjunctiva, simple and smaller, has no appendages. The vesica is a very long sclerotized capillary tube, which is coiled when at rest, lying close to the distal end of the phallosoma. Extension and retraction of the vesica can be observed easily if the phallus is placed in distilled water and then in glycerin. According to DRAKE & DAVIS

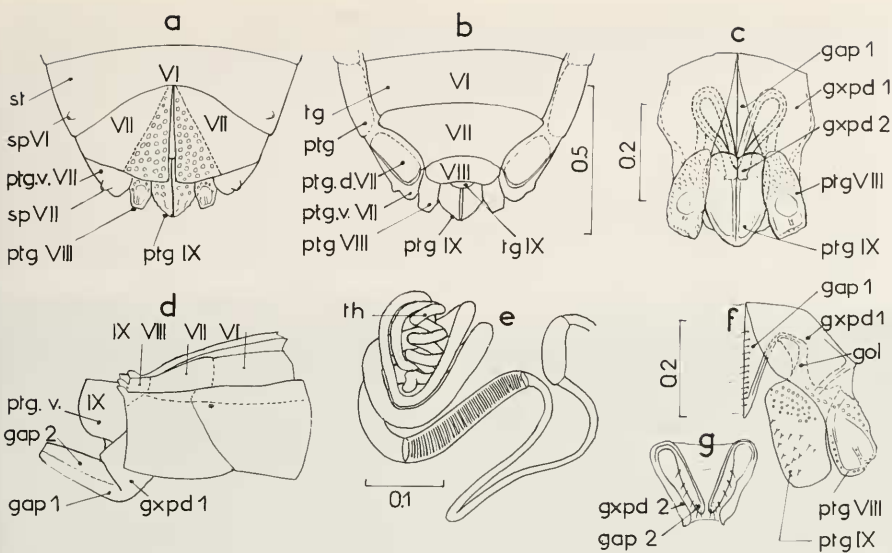


Fig. 5: Genital urites of *Piesma maculatum* ♀, ventral view; b, id., dorsal view; c, id., external genitalia, ventral view; d, genital urites of *P. cinereum* ♀, ovipositor extricated; e, spermatheca of *P. maculatum*; f, first pair of gonapophyses and associated structures of *P. maculatum*; g, id., second pair of gonapophyses. – gap 1, gap 2 = gonapophyses I and II; gxp.d. 1, gxp.d. 2 = gonocoxopodites I and II; ptg = paratergites; ptg. d. = paratergite, dorsal part; ptg. v = paratergite, ventral part; sp = spiracles; st = sternites; tg = tergite; th = terminal helix of spermatheca; VI–IX numbers of urites. – Scale in mm. – (Originals, except d, which is after DRAKE & DAVIS, 1958).

(l. c.), this movement could occur similarly during copulation at the entrance to the female's genital chamber and would help the tube penetrate into the spermatheca. The genital apparatus of the male *Piesma* has no annexed glands, neither before nor behind the bulb.

#### Female genital segments<sup>5</sup> (figs. 5 a, b, c, d, e, f, g):

Visible on the dorsal side are tergite VII with a dorsal paratergite on each side, the much smaller tergite VIII and the very reduced tergite IX, difficult to discern under the extremity of tergite VIII. The apical appendices visible from above all belong to ventral structures.

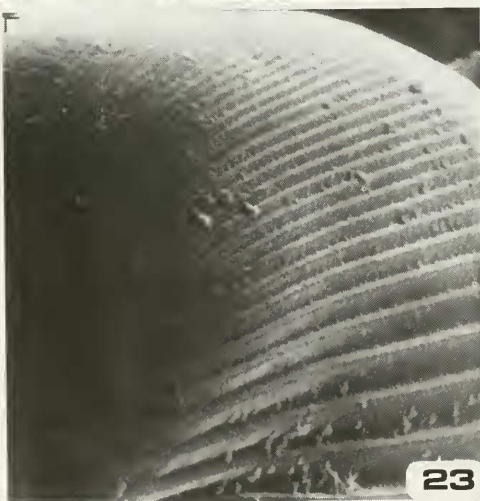
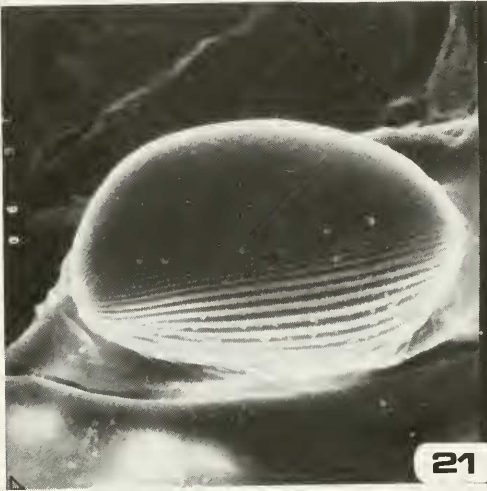
On the ventral side, all the sclerites are paired. Sternite VII, enclosing the ovipositor, is longitudinally completely cleft in the middle and the two resulting half-sternites form a triangular plate, which enlarges from the base to the tip and whose surface is densely areolate. These two plates are distally free and can be opened along the cleft, making way for the extension of the ovipositor. In a laterodistal position of each half-sternite VII there is a

<sup>5</sup> The external morphology of the terminal segments of the female abdomen of *Piesma* has given rise to various interpretations. In their 1975 publication, the authors corrected numerous errors by WAGNER (1953, 1954, 1966) but misindicated the terminal cone to belong to the posterior gonapophyses. The nomenclature given here is based on the descriptions by SCUDDER (1959) and ŠTYS (1961) and not entirely on those of DRAKE & DAVIS (l. c.), which are also partly inaccurate.



sclerite forming the lateroposterior margin of the abdomen and bearing the last spiracle. This sclerite is the ventral paratergite VII. The two convex, contiguous half-shells with finely areolate tegument forming a coneshaped projection at the ventrodistal apex of the abdomen are the paratergites IX. Visible on both sides of this cone are two small lobes, the paratergites VIII.

The ovipositor, which is evaginable, consists of two pairs of gonapophyses in close coaptation. When the ventral genital complex is visible after dissecting urite VII, urite VIII is mainly represented by the two gonocoxopodites I which are fused on their posterior margin with paratergites VIII. Attached to them are first gonapophyses; the flexible connections are the outer rami.



Photos 21–24: Stridulatory apparatus of *Piesma quadratum* (Austria). 21, 23, lima at tergite I; 22, 24, transverse structures on cubital vein, ventral.



The basal connection of the gonapophyses I is membranous and their inner margin is not dentate but bears a row of setae. They are connected with the gonangulum, a weakly sclerotized part of paratergite IX, by means of a flexible sclerotized structure, the inner rami. The gonapophyses II, also not dentate, are joined together by a membrane and are connected by a flexible ramus with the second gonocoxopodites, situated along the inner margin of paratergites IX.

The vagina opens into the tube formed by the fusion of the two pairs of gonapophyses. It ends in a small genital chamber which receives the common oviduct and where, on the dorsal wall, a long tubular spermatheca also ends. This spermatheca (fig. 5 e), easily visible by coloring it with chlorazol black, consists of a basal tube and a very long apical coiled gland whose wall is annulate. The arrangement of coiling and its length vary within the range of the subgenera. Each of the ovaries has only six ovarioles.



Photo 25: Leaf of beet, damaged by nutritional stings of *Piesma quadratum*. (Published with the permission of the Institute for Phytopathology, Aschersleben).



Photo 26: Symptoms of the leaf curl virus on fodder beet. (Institute for Phytopathology, Aschersleben).

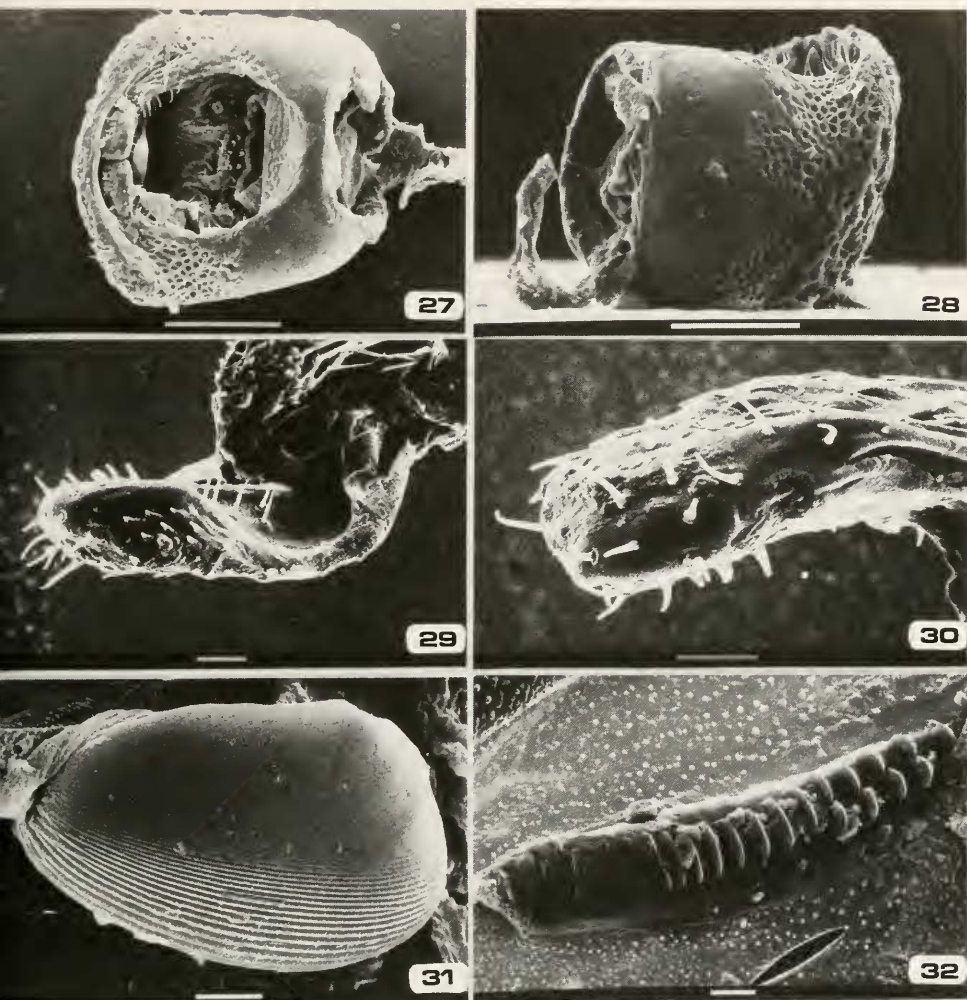
#### Stridulatory apparatus (figs. 2 e, 3 d, photos 21–24, 31, 32):

The existence of a stridulatory apparatus in the male *Piesma* has been known since a publication by H. SCHNEIDER (1928); the organ was later studied in detail, notably by LESTON (1957). The base of the cubital vein of the posterior wing in the male *Piesma* is thickened and its surface bears ventrally a large number of fine transverse ridges showing specific differences (figs. 2 e, 3 d, photos 22, 24, 32). At rest, this portion of the wing is situated directly above a small ovate, convex sclerite with transverse ridges.<sup>6</sup> This sclerite, probably derived from the first abdominal tergite, has been termed *lima* by LESTON (l. c.). The dorsal wall of the abdomen between tergites I and II is invaginated to form a large phragma to which robust longitudinal muscles are attached. Apparently, the action of muscles effects back-and-forth movements in tergites I–II, drawing the *lima* to rub against the striated surface of the cubital vein, thereby producing sound. The ecological aspects of the stridulation will be mentioned later.

The stridulatory system is also present in the female, but much less developed, even rudimentary, and probably not functional.

Besides this apparatus, there are small striated ridges (figs. 2 b, d) on the undersurface of the hemelytra, on the one hand toward the base of the hypocostal lamina and on the ot-

<sup>6</sup> SEM investigations have shown, that the setae on the *lima* as indicated by LESTON (l. c.) are not existing.



Photos 27–32: *Piesma kerzhneri* n. sp. (Paratype). 27, 28, pygophore; 29, 30, paramere; 31, lima of stridulatory apparatus at tergite I; 32, stridulatory structure on cubital vein. Scale: 27, 28 = 100 microns; 29–32 = 10 microns.

her hand on the apical tip of the clavus. According to MAYER (1940), these structures form part of the stridulatory apparatus, but their location and structure do not correspond to such a function (photos 7, 8, 10).

#### Cytology:

Without going into detail on this subject, it is known that the chromosomal formulas, named karyotypes, usually indicate the number of paired or autosomal chromosomes (2A) and the presence of sex chromosomes which in the *Hemiptera* are mostly XY (male)

or XX (female). SOUTHWOOD & LESTON (1959) specified the karyotype of *Piesma quadratum* as  $2n = 40 + X + Y$  ( $A = 20$ ). The same authors noted a curious observation. At the time of the last phase of cellular divisions or meiosis (spermatogenesis), the chromosomes of *Piesma quadratum* link to one another forming a giant chromosome.

### III. Immature Stages and Development

Egg (figs. 6 a, b, c):

The eggs of about half of the species have been figured and described in brief by PUTSHKOV (1974). WILLE (1929) earlier described the eggs of *Piesma quadratum* and LEE & PARK (1971) those of *Piesma maculatum* and *P. josifovi* (referred as sp. B.). Furthermore, the authors have observed those of *Piesma variabile* and *P. silenes*.

The eggs of *Piesmatidae* are of the pentatomorphic type and do not have an operculum, although their flat anterior area resembles a cap (pseudoperculum) at first glance. They are hardly or not at all curved longitudinally, but the dorsal side is more convex than the ventral side. The body of the egg is almost fusiform with the posterior pole slightly rounded and the anterior pole obliquely truncated. The chorion, smooth or granular, has 6 to 10 longitudinal carinae obliterating before the poles. On the cephalic pole there are

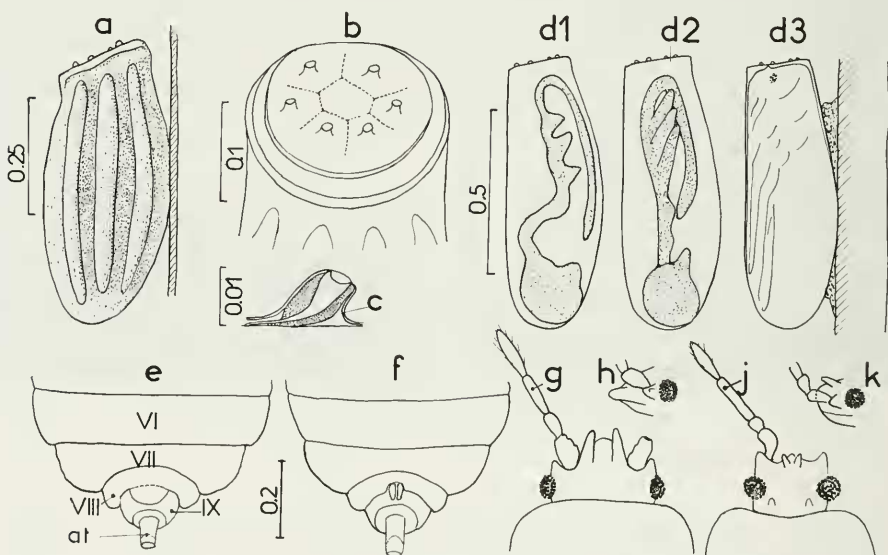


Fig. 6: a, Egg of *Piesma quadratum*, attached to substratum; b, id., cephalic pole; c, section of an aero micropylar process; d1-d3, three different stages of embryonic development of *P. maculatum*; e, terminal segments of male fifth nymphal instar of *P. variabile*; f, id., of female; g, head and left antenna of fifth nymphal instar of *P. variabile*; h, id., head, lateral view; j, k, same parts of fifth nymphal instar of *Acalypta nigrina* (Tingidae). - VI-IX, number of urites. - at = anal tube. - Scale in mm. - (a, b: after WILLE, 1929; c, after SOUTHWOOD, 1956; d, after COBBEN, 1968; e-k: Originals).



four to eight aero-micropylar processes arranged like a crown, bearing the aero-micropylar openings; in the center is a regular polygonal plate at whose edges radial sutures start. These are the boundaries of large follicular cells and are the ecdysal lines, along which the eclosion rupture takes place. From fig. 6b it can be seen that each aero-micropylar-cup is situated between two radial lines and thus located at the center of one follicular cell, from where each cup is produced.

In the known cases, the length of the egg varies between 0.4 and 0.7 mm. The coloration of the freshly deposited egg is light and then turns from brownish yellow to more or less dark.

#### Embryonic development (figs. 6d<sub>1</sub>, d<sub>2</sub>, d<sub>3</sub>):

COBBEN (1968) studied the development of the embryo in *Piesma maculatum*. The differentiated germ band is endoblastic as is the case in many *Heteroptera*, meaning that it penetrates into the yolk at an early stage and the embryo is thus formed inside the egg and not on the surface. This invagination starts near the posterior pole and the band remains in the sagittal plain. Note is made at a certain stage (fig. 6d 1) of the gibbous sinuosity of the postcephalic region and also of the curving of the apical extremity along the convex side of the egg. Finally, the so-called blastokinesis phase takes place, which consists here of a simple reversion, leading the head to the anterior pole and the dorsal part onto the convex surface of the egg, which is the one normally applied to the substrate. Development continues with formation of the legs, antennae and the mouth parts, the pigmentation of the eyes and the dorsal closure of the embryo.

According to WILLE, the duration of embryonic development of *Piesma quadratum*, which strongly depends on the given temperature, takes 22 to 24 days in an insectarium at about 16° C, only 17 days at 18 to 20° C and can drop to 12 to 14 days at a slightly higher temperature; in its natural environment it probably takes two to three weeks. According to WILLE's description, after an incubation of ten days, the stage of development approximately corresponds to fig. 6d 1. The legs and antennae are discernible through the transparent shell toward the twelfth or thirteenth day as well as the segments of the body and the two red ocular spots. The indications made by PARK & LEE (1975) on *Piesma maculatum* in Korea are very comparable.

#### Hatching:

WILLE also described the hatching of the *Piesma quadratum*, observed in the laboratory. This takes place by rupture of the radial sutures of the anterior pole under the pressure of an egg burster on the cephalic region of the cuticle. The embryo effects rhythmic antiperistaltic convulsions which push the head outside. Then the antennae are extracted from the embryonic cuticle which held them alongside the body. The thorax appears next, allowing the fore and middle legs to free themselves. Once a pair of legs is free, hatching quickly comes to an end. The legs allow the nymph to support itself on the egg's shell and emerge; the abdomen is thus extricated but the insect finds itself held back in its embryonic cuticle by its hind legs, which also prevent it from falling out of the egg until it can move enough to grasp the support and completely free itself. The embryonic cuticle, which was extracted from the egg's shell, remains attached to it at the level of the aero-micropyles of the anterior pole.

The total duration of hatching varies from half an hour to six hours. Its success depends on a certain degree of humidity, the lack of which will cause the nymph to die—a situation

frequently observed by WILLE in an insectarium when an absence of proper precautions caused the atmosphere to be too dry.

The young nymphs start to feed almost immediately with the first sting sometimes occurring only ten minutes after hatching.

### Nymphs:

As with all the *Heteroptera*, there is no fundamental difference between the nymphal instars of *Piesma* and the adult with regard to their general organization. The insect normally goes through five successive moults (ecdysis), each one accompanied by small morphological modifications. The last one, which produces the imago, brings more important structural changes, notably the complete development of the hemelytra, the wings and the sexual organs.

The immature stages of *Piesma* resemble those of the *Tingidae* with their small size, their short and very flat shape, their short legs and antennae and their slow movements. Their coloration is generally greenish on the whole body, sometimes there are black spots and lines (*P. maculatum*); the appendages are whitish and apically slightly dark.

In the front of the head the juga are easily visible on each side of the clypeus beginning with the second instar, at the fourth instar they can reach the level of its anterior apex. The shape of this frontal region of the head is characteristic and allows one to distinguish immediately between a larva of *Piesma* and that of a *Tingidae* species (figs. 6g, h, j, k). In *Piesma variabile*, the carmine red eyes already have about ten ommatidia in first instar and these are numerous in the following instars. There are no ocelli. The antennae of the younger instars are relatively thick with an hypertrophy of the terminal article.

The wings appear progressively. While they are completely absent in the first and second instars, in the third instar they appear as simple lobes of the lateroposterior margin of the meso- and metanotum. In the fourth instar, the hemelytral lobes and the alar lobes (of the hind wings) are already quite developed with the first ones partly covering the second ones and reaching the second abdominal tergite. In the fifth and last instar, hemelytral lobes reach the middle of tergite IV and hide the alar lobes except on the inner margin.

The legs of the young nymphal instars are very robust; the tarsi only have two segments in all instars, just as the adults. The parempodia are present and even very developed as soon as the insect is hatched. The authors observed that the claws were missing in the first instar of *Piesma variabile*. According to LEE & PARK (1971, fig. 3 and 6) they appear to exist in the first instar of *Piesma maculatum* and *Piesma josifovi* (referred as sp. B.).

In all nymphal instars, the two dorso-abdominal scent glands appear in the form of reddish spots under the cuticle of tergite IV (sometimes extending on III and V). The orifices emerge at the middle of the posterior margin of tergites III and IV.

In the nymphs of the fifth instar, the sexual organs are discernible on the apex of the ventral side. In the male, the sternite VIII bears at its apex a rounded lobe which proceeds under urite IX (fig. 6e). In the female, it has a slight incision with two small structures indicating the external genitalia (fig. 6f).

The body of the nymphal instars is subglabrous, as in adults, and sternites V and VI of the abdomen have a trichobothrium on each side. In *Piesma kochiae*, *P. tenellum* and *P. kolenatii*, the dorsal side of the body is more or less covered with small spiniform tubercles in the fifth instar.

In all instars, the ecdysial sutures are visible, although very feebly, on the top of the head and on the dorsal median longitudinal line of the three thoracic segments.

The proportions of the body, and notably those of antennal segments and of the legs, change progressively during growth as is shown in figs. 7 a-e. It is the same for the rostrum, which is thicker and longer in the younger instars. Moreover, these nymphal particularities are common to all Geocorisae.

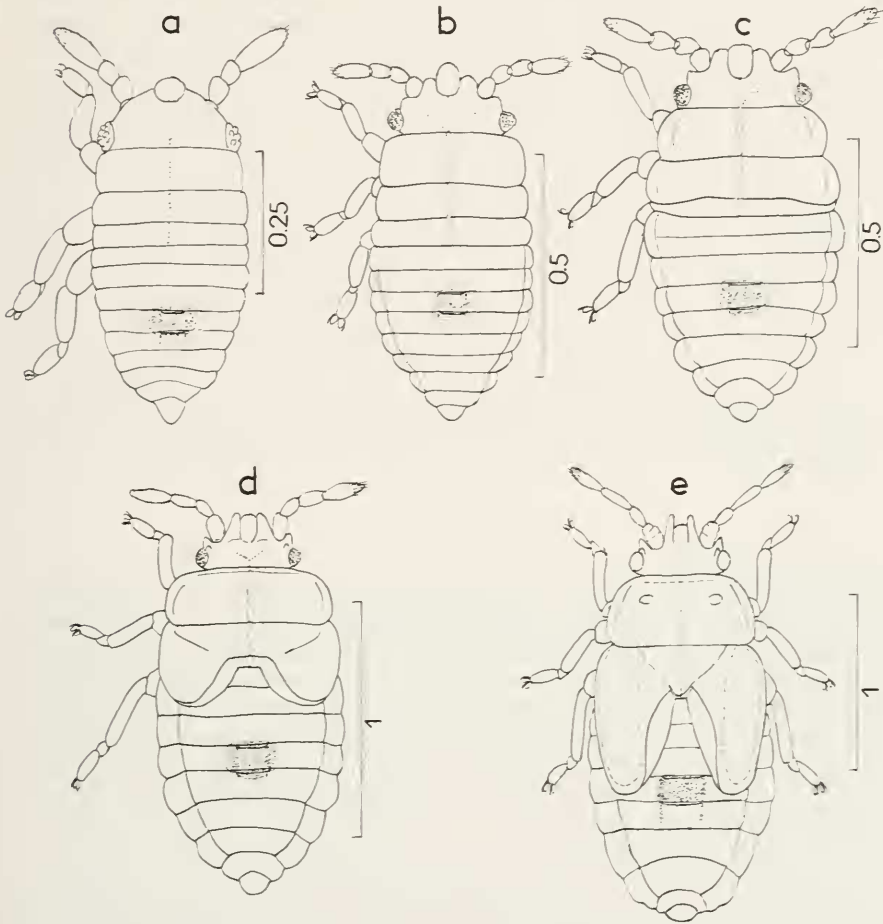


Fig. 7: *Piesma variabile*, nymphal instars. - a, instar I; b, instar II; c, instar III; d, instar IV; e, instar V. - Scale in mm. - (Original).

The diagrams in fig. 8 b show the variation in length and width from first to fourth instars of *Piesma quadratum* according to WILLE. The duration of the nymphal stages in the same species at 18° C to 20° C is shown in fig. 8 a, where it can be seen that full nymphal development takes about 40 days. For *Piesma maculatum*, PARK & LEE (1975) give a shorter duration; however, the comparison of the experimental conditions is not easy.

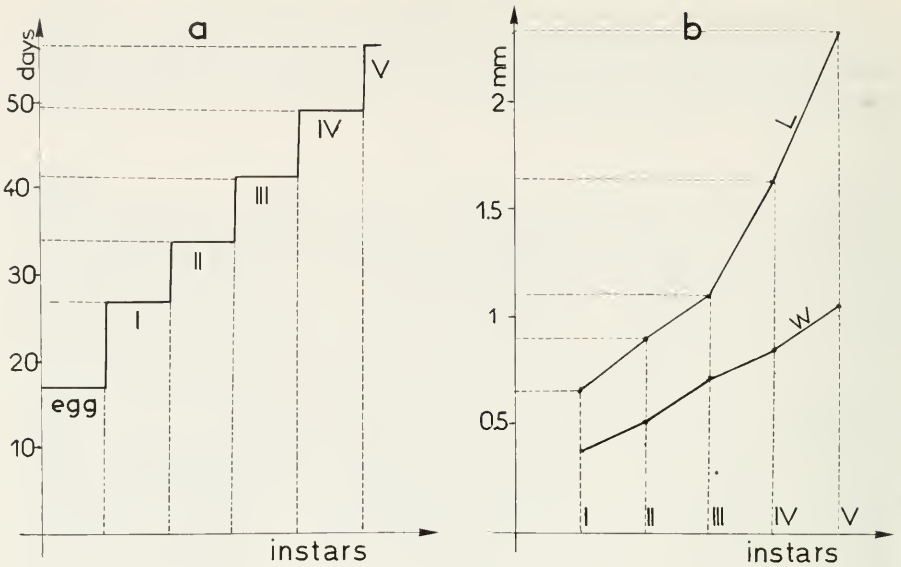


Fig. 8: a, Average duration of nymphal development of *Piesma quadratum* at a nearly constant temperature of 18–20° C; b, development of overall length (L) and width of abdomen (W). – (data after WILLE, 1929).

### Nymphal moulting:

Here, the authors again refer to WILLE, who described the moulting of *P. quadratum*. Under internal pressure, the ecdysial sutures of the old cuticle, otherwise mainly dehiscent, split off, and the head emerges first followed by the thorax and the legs, extricating themselves from their enclosure one by one. The abdomen frees itself last and the old cuticle is abandoned. In rare cases, this exuvia remains attached to one leg or the abdomen, and is trailed along by the insect until its next moulting. It was noted that the nymph stopped feeding during the last 24 hours preceding an ecdysis and resumed its nutritional stings 10 to 12 hours after moulting. The duration of one moulting process takes from one half hour to three hours.

Imaginal moulting takes place analogous to the preceding form. The wings and hemelytra, which are folded and wrinkled during ecdysis, become smooth and resistant within one or two hours. The coloration, which is first whitish all over except on the abdomen which is greenish in color, slowly changes to that of the mature adult in eight to nine days.

An identification key for the nymphal instars is given on page 100. A key for the known nymphs of the palaeartic *Piesma* is also given.



#### IV. Ethology and Ecology

##### Biotopes and host plants:

With the exception of several very tolerant ubiquitous species, the Palaearctic *Piesma* are xerophilous or halophilous and prefer well exposed, sandy places, steppes and sub-tropical areas. These small *Heteroptera* are strictly phytophagous and those in our regions live only on a limited number of plant families belonging to the order of *Centrospermales*. So the *Chenopodiaceae* of the genera *Chenopodium* and *Atriplex* attract *Piesma maculatum*, *P. capitatum*, *P. kolenatii* and *P. quadratum*. Further *P. salsolae* is found on *Salsola* and *P. kochiae* on *Kochia*. The *Caryophyllaceae* are chosen by a group of xerophilous European *Piesma*: *P. variabile* and *P. pupulum* live on *Herniaria*, *P. silenes* on *Dianthus*, *Silene* or *Tunica* and *P. unicolor* on a *Silene*. The North American species show analogous trophic preferences; however, from the little that is known it seems that this does not apply to the tropical *Piesma*: one of the authors collected *Piesma linnavuorii* in the Republic of Chad only on the arborescent *Leguminosae* such as *Acacia nilotica* and *Tamarindus* sp. This choice is near that of the *Piesmatidae* of the Australian genus *Mcateella*, which live probably also on *Acacia*.

It was from the wild *Chenopodiaceae* that *Piesma quadratum* was able to invade the European sugar beet and fodder beet cultures, where it was dreaded for the infectious diseases it can transmit and not for the minor damage it causes directly. This question will be discussed in detail later. In North America, *Piesma cinereum*, whose wild host plants are *Amaranthus*, *Chenopodium*, *Atriplex*, *Salsola*, etc., also transmits pathogenic agents to the sugar beet cultures.

##### Nutritional stings:

WILLE (1929), and later EHRHARDT & SCHMUTTERER (1965), minutely studied the method of stinging of *Piesma quadratum*. The nutritional stings are preceded by a phase in which an auspicious place is searched for, where touching with the antennae and with the apex of the still semi-retracted rostrum takes place. At the time of the sting the rostrum is vertical or pointed slightly to the rear. As soon as the stylets are inserted, the labium is raised and swings back against the prosternum. The insect stays almost immobile while the stylets slowly penetrate to the maximum depth as well as during the nutritional sting. This can take from ten minutes to six hours, at an average of two to three hours. Probably, the entire fascicle is engaged, with the mandibles and maxillae working in coaptation. The study of the trail of the stings in consecutive sections showed that a drop of saliva was deposited externally at the place of perforation and showed the existence of a salivary sheath all along the path of the stylets. The fascicles penetration is essentially intercellular, more or less curved, not only in one direction, which proves that there is a directional control. The stings are effective in the phloem and probably in the phloem vessels themselves as in the case of the aphidian stings, as is also ascertained by analysis of the faeces. This behaviour separates the *Piesma* from all the other phytophagous *Heteroptera* and explains why they are the only ones able to transmit viral diseases diffused by circulation of sap. The circular yellowish traces left behind after the stings seem to be caused only by the suction of some of the subepidermic (parenchyma) cells while the fascicle is passing.

### Pairing and Mating:

The stridulatory organs of *Piesma* play an important role in the phase preceding pairing. The sounds made by *Piesma quadratum* have been analyzed by HASKELL (1957). These mainly consist of short emissions of two types, repeated at regular intervals.

They differ in their intensity and in the cadence of their repetition: "rapid" stridulation consists of nine low-level emissions per second while "slow" stridulation runs at 5.5 or 6 per second with an intensity three to four times higher. According to SOUTHWOOD & LESTON (1959), in the mating season, the male *Piesma quadratum* emits stridulation at a rate of nine emissions per second more or less continuously, causing populations to assemble. Sexual calls with 5.5 emissions per second replace the foregoing during preliminaries to copulation.

The *Piesma* mate by superposition with the male mounting the female and shifting to one side. WILLE gave a very detailed description of the copulation of *Piesma quadratum*, which can be summed up as follows. Pairing starts with a courtship. The male moves its antennae up and down, goes just up to the female and touches her with its antennae. Then it takes a position beneath the female, goes back, then forward and finally mounts her. Its fore legs grasp the anterior angles, while the middle legs are on the posterior angles of the female's pronotum and the hind legs are alongside the hemelytra. The male then extends its abdomen, devaginating the eighth and ninth urites, which, at rest, are telescoped into the seventh. It moves the abdomen to the left side of the female by leaning its whole body to the left, suspended from its points of contact. The apex of the abdomen moves under that of the female and curves back to the right and upwards. The female has thus lowered the two lobes of her seventh sternum and the male, probably seizing the gonapophyses between its parameres, introduces its tubiform phallus into the genital tract. During this entire phase, which takes from 30 seconds to five minutes, the female remains almost passive.

The male then remains immobile on the female while the latter moves to sting the host plant and shows the same activity as if her partner did not exist. The connection is intensive when the capillary tube of the phallus has penetrated into the long spiral spermatheca. Copulation can last from one to six hours. After termination, the male usually remains on the female; it may stay there for the whole day and even for several days, often even remaining there during oviposition.

Probably other species show analogous behaviour: a significant part of the populations is observed paired during favorable periods of spring, for example *P. maculatum*, *P. variabile*, *P. pupula*.

### Oviposition:

Mating is followed very closely (within several days) by oviposition. The eggs are deposited either on the living branches and leaves of the host plants or on nearby dry ones. The female *P. quadratum* moves in a direction parallel to that in which the egg is to be laid, protracts the extremity of the abdomen contacting the substratum and moves along, seeming to "test" it. The two triangular lobes of sternum VII open and the ovipositor expands. The egg, of shiny appearance, quickly slides out and attaches itself to the substratum, to which its dorsal side adheres almost immediately due to an adhesive coating. It is not known whether this secretion is deposited on the substratum before the egg, or on the egg itself, or on both. The duration of oviposition does not exceed five minutes.

This sticking of the eggs is certainly common to all species of the genus *Piesma*. Besides *P. quadratum* it was observed in *P. capitatum* and by the authors in *P. variabile* and *P. silenes*.

The fertility of *P. quadratum* is quite high (see page 115); that of other species has not yet been studied in detail.

#### Annual cycles:

The adult *Piesma* hibernate in the litter at the foot of their host plants. In the case of *Piesma quadratum*, and probably that of other very widespread species, the macropterous adults move by flight or small migrations from the beginning of spring before the mating season. In contrast, mobility is not as strong in species where the macropterous forms are rare, as the *P. variabile*, *P. pupula* or *P. silenes*, whose populations, moreover, are localized in a certain number of distinct places and do not leave their pluriannual host plant.

Mating and oviposition take place in spring, more or less late depending on the species and the climate. The *Piesma* often live in large groups, nymphs of different instars and adults confined close to the places of eclosion. This gregarious behaviour during the development phase closely resembles that observed in many *Tingidae*.

*Piesma quadratum* and *P. maculatum* generally have two generations per year, in which case the young adults of the first generation appear at the beginning of summer, mate, and lay their eggs, producing summer nymphs, which finish their development before the beginning of autumn. The annual cycle is not known in the other species.

#### Economical importance:

The species harmful to the cultures of *Chenopodiaceae* (beets, spinach) are of economic importance. Information on this subject can be found in the chapter on the biology of *Piesma quadratum*. The authors also note that, under certain conditions, *P. maculatum* causes (minimal) damage to beet cultures; however, no transmission of pathogenic agents has been attributed to it.

### V. Phyletic Origin of the Piesmatidae

The general habitus of the *Piesma* and in particular the reticulation of their tegument as well as their biarticulated tarsi led most (but not all) earlier authors, as those recalled in our brief history (see chapter I), to consider them close to the *Tingidae*. It is known that these similarities are only convergences of minor phyletic value.

Knowledge of the comparative morphology of the higher categories of *Heteroptera* in relation to their phylogeny has considerably improved during the last thirty years. LESTON, PENDERGRAST & SOUTHWOOD (1954), basing their work mainly on those of TULLGREN (1918) concerning abdominal chaetotaxy and of SINGH-PRUTHI (1925) for male genitalia, as well as their own research, proposed to divide the *Geocorisae* into two phylogenetic sections: *Pentatomorpha* and *Cimicomorpha*. On the other hand, the studies performed on the male and female genital structures (PENDERGRAST 1957, SCUDDER 1959), on mouth parts and salivary glands (SOUTHWOOD 1955, COBBEN 1978), and on eggs and embryonic development (SOUTHWOOD 1956, COBBEN 1968), confirmed in many respects the scheme of LESTON et al. However, the discussions on those subjects remain open. Note that COB-

BEN in his syntheses (1968, 1978) proposed a separation of the *Cimicomorpha* into two major independent groups. On the other hand, the infraorder of *Pentatomorpha* which also benefited from the studies by ŠTYS (1961, 1965, 1967), SCUDDER (1963), SCHAEFER (1964, 1965, 1975), and ŠTYS & КЕРЖНЕВ (1975) does not seem seriously challenged in late years.

The *Piesmatidae* certainly belong to the *Pentatomorpha* and show all their major characteristics: abdomen with trichobothria on the ventral side,<sup>7</sup> claws with parempodia, hind wings with distinct R and M veins and lacking subcostal veins, female spermatheca unpaired and functional, male phallus clearly differentiated into phallosoma, endosoma and vesica, accessory salivary glands of the tubular type, eggs without operculum, opened by means of a frontal egg-burster of the embryonic cuticle.

The position of the *Piesmatidae* in this infraorder is still subject to discussion. They are close to the *Lygaeidae-Coreidae-Pyrrhocoridae* complex and possess various of its characteristics: antennae and rostrum quadriarticulated, abdominal spiracles mainly in dorsal position. They are certainly closely related to the *Lygaeoidea* and possibly more particularly with the group of taxa called "Malcid line" by SCHAEFER (1975), which comprises the *Colobathristidae*, *Malcidae*, *Berytidae* and the subfamily *Cyminae* of the *Lygaeidae*. The presence of four or five simple veins on the hemelytral membrane is common to these families or subfamilies as well as the fact, that they show similarities in the structure of the connexivum, the genital organs of both sexes, in the disposition of the spiracles and the fusion of certain abdominal urites.

Nevertheless, the *Piesmatidae* are distinguished by a series of characters, some of which are unique or almost unique among the *Heteroptera*: metasternal odoriferous glands of a peculiar type (CAPAYON, 1962), prothorax with propleural cavities, male genital tract lacking subsidiary glands, remarkable morphology of the last abdominal urites (male, female), bifurcated MALPIGHI tubes, existence of a special stridulatory apparatus.

Consideration of several of these morphological features as well as of several others, such as the form of the spermatheca, led ŠTYS (1961) to create a superfamily *Piesmatoidea*.

This point of view was supported by CAPAYON (l. c.) and accepted by COBBEN (1978) but disputed by SCHAEFER (1964, 1975). This author, without ever making a definitive judgment, joins SOUTHWOOD (1956) to include the *Piesmatidae* in the *Lygaeoidea*, near the *Lygaeidae* and related families. More precisely, according to ŠTYS (1965), the *Pentatomorpha* would be divided into *Pentatomoidea*, *Piesmatoidea*, *Idiostoloidea*<sup>8</sup> and *Coreoidea* (including *Coreidae*, *Lygaeidae*, *Pyrrhocoridae* etc.), and, according to SCHAEFER (1966), into *Pentatomoidea*, *Coreoidea* s. str., *Lygaeoidea* (including *Berytidae*, *Colobathristidae*, *Piesmatidae*, *Idiostolidae*) and *Pyrrhocoroidea*. SCUDDER (1963) arrived at a conclusion which, at the superfamily level, differed from that of SCHAEFER by incorporating the *Pyrrhocoroidea* into the *Lygaeoidea*.

The latest overall review of higher taxa in recent *Heteroptera* was given by ŠTYS & КЕРЖНЕВ (1975). Their proposed classification includes the *Piesmatoidea* as a distinct superfamily in the infraorder *Pentatomorpha*, the same rank as attributed to *Aradoidea*, *Idiostoloidea*, *Coreoidea* and *Pentatomoidea*.

The discrepancies in the opinions of hemipterists consist primarily of differences in interpretation of the phyletic value (primitive or evolved) of various characters and are also

7 These trichobothria are found in all *Pentatomorpha* except *Aradoidea*.

8 Small neotropical group.

possibly due to divergencies in the significance ascribed to the superfamilies in a classification. In the absence of a significant number of fossil forms, it appears very difficult to settle such question today.

Without any doubt, the *Piesmatidae* are of very ancient origin within the *Heteroptera*. This is directly attested to by the present distribution of its representatives: not considering the little known subfamily *Thaicorinae*, the three genera which presently constitute the family are each found on a continent or group of continents isolated from the others very long ago – *Mateella* in Australia, *Miespa* in South America and *Piesma* in Africa, Eurasia and North America, three regions between which communication exists or existed in a relatively recent period.

The relations between the genus *Piesma* and the other *Piesmatidae* were discussed by SCHAEFER (1971, 1981) with the help of a cladistic analysis based on the characters of the three known genera just mentioned and as defined by DEANE & DAVIS (1958). The genus *Piesma* shows several "primitive" characters compared with those presented by the two others: hemelytral membrane mainly hyaline in the macropterous forms and having four easily visible veins, a smaller number of spiracles in dorsal position (five instead of six), persistence of two pairs of abdominal trichobothria. It can thus be presumed to be the oldest, but the degree of certainty of these deductions is low.



## Second Part: Systematics

### Superfam. *Piesmatoidea*

#### I. Fam. *Piesmatidae* AMYOT & SERVILLE, 1843

Type genus: *Piesma* LE PELETIER & SERVILLE

*Piesmides* AMYOT & SERVILLE 1843: 300

*Aradites*, subfam. *Piesmoeideae* SPINOLA 1850: 44

*Zosmenidae* DOHRN 1859: 41

*Zosmoridae* DOUGLAS & SCOTT 1865: 22

*Piesmididae* WALKER 1873: 175; HORVÁTH 1911: 14; GULDE 1938: 226; STICHEL 1957: 35, Hsiao et al. 1981: 216

*Tingitidae* subfam. *Piesmina* STÅL 1873: 115

*Tingitides* subfam. *Piesmidae* PUTON 1875: 28

*Tingitides* trib. *Piesmini* PUTON 1879b: 84

*Tingitidae* subfam. *Piesmina* SAUNDERS 1892: 120

*Tingitidae* subfam. *Piesminae* HORVÁTH 1906: 2

*Piesmatidae* STICHEL 1926: 102; HACKER 1927: 30; HOBERLANDT 1942: 123; DRAKE & DAVIS 1958: 567; HEISS & PÉRICART 1975: 517; ŠTYS & KERZHNER 1975: 74; SCHAEFER 1981: 536

Brief diagnosis: Family of *Heteroptera*, *Pentatomorpha*, which possesses in common the following set of characters not shared by other families:

Ocelli present. Antennae short, four-segmented. Rostrum also four-segmented. Tegument reticulate on pronotum, on sclerotized part of hemelytra and some other parts of the body. Prosternum with propleural cavities. Legs short, tarsi two-segmented, claws with parempodia and pseudopulvilli. Female genitalia consisting of an unpaired spermatheca formed by a long coiled tube. Male genitalia symmetrical. Phallus of the male differentiated into phallosoma, endosoma and a long tubular vesica.

Four genera are known, of which only the genus *Piesma* shows Palaearctic and Nearctic distribution.

#### Key to genera. Adults

- 1 (2) Spiracles II to V dorsal, VI and VII subventral laterally. Sternites V and VI each with a pair (1+1) of trichobothria. Mesopleural tubercles developed, simple. Genus recorded from Europe, Asia, Africa and North America . . .  
..... *Piesma* LE PELETIER et SEVILLE (p. 93)
- 2 (1) Spiracles II to VI dorsal, VII subventral laterally. Sternites V and VI without trichobothria . . . . . 3
- 3 (6) Abdomen lacking trichobothria. Head declivant. Jugal not completely surpassing clypeus anteriorly . . . . . 4
- 4 (5) Membrane with four veins. Mesopleural tubercles absent. Posterior wings with a hamus. Genus recorded from South America only. Monospecific. Distribution: Chile . . . . . (*Miespa* DRAKE)

- 5 (4) Membrane without veins. Mesopleural tubercles prominent, bifurcate. Posterior wings lacking a hamus. Australian genus represented by four known species . . . . . (*Mcateella* DRAKE)
- 6 (3) One pair of trichobothria present on sternite VII. Head prognathous. Jugal surpassing clypeus anteriorly. Indomalayan genus, represented by only one species known . . . . . (*Thaicoris* KORMILEV)

II. Gen. *Piesma* LE PELETIER & SERVILLE, 1828

Type species: *Acanthia capitata* WOLFF, 1804

*Acanthia* in WOLFF, 1804: 131. – *Tingis* subg. *Piesma* LE PELETIER & SERVILLE, 1828: 653. – *Agrammodes* UHLER, 1895: 56. – *Aspidotoma* CURTIS, 1833: 196. – *Zosmenus* LA PORTE DE CASTELNAU, 1833: 49; auctt. – *Zosmerus* BURMEISTER, 1835: 262.

DRAKE & DAVIS 1958:573; PERICART 1974: 53; HEISS & PÉRICART 1975: 517.

Brief diagnosis: Head prognathous, preocular tubercles single or double. Mesopleural tubercles developed but small. Membrane of hemelytra with four non-anastomosed veins in macropterous and submacropterous forms. Odoriferous channels discernible. Abdomen with a pair of trichobothria on sternites V and VI. Abdominal spiracles II to V dorsal, the following ventrolateral. Habitus generally resembling that of *Tingidae*. Secondary sexual characters developed: anterior processes of jugs longer in males than in females.

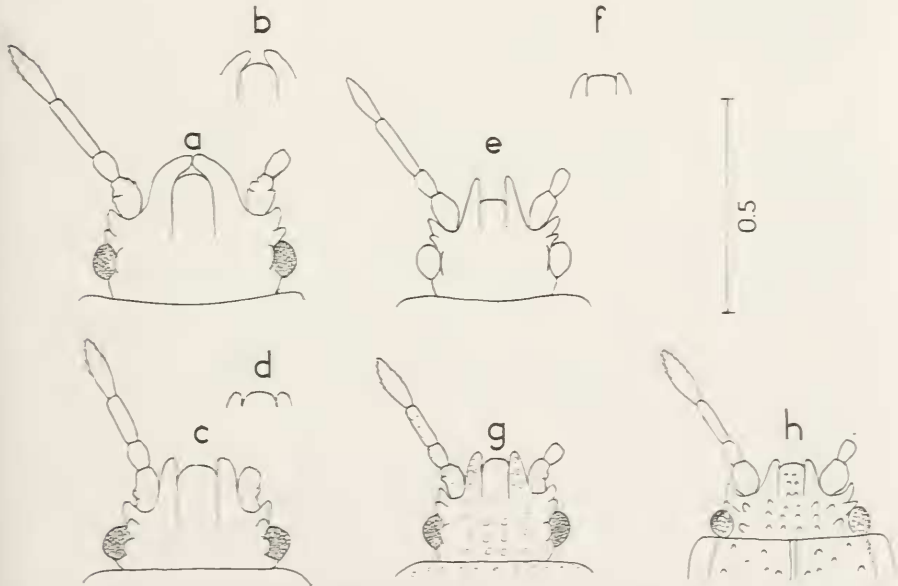


Fig. 9: Head and antennae of fifth nymphal instars of *Piesma*. – a, *P. quadratum* ♂; b, id. ♀, jugal appendices; c, *P. pupula* ♂; d, id. ♀, jugal appendices; e, *P. salsolae* ♂; f, id. ♀, jugal appendices; g, *P. rotundatum* (sex unknown); h, *P. kochuae* (sex unknown). – Original.

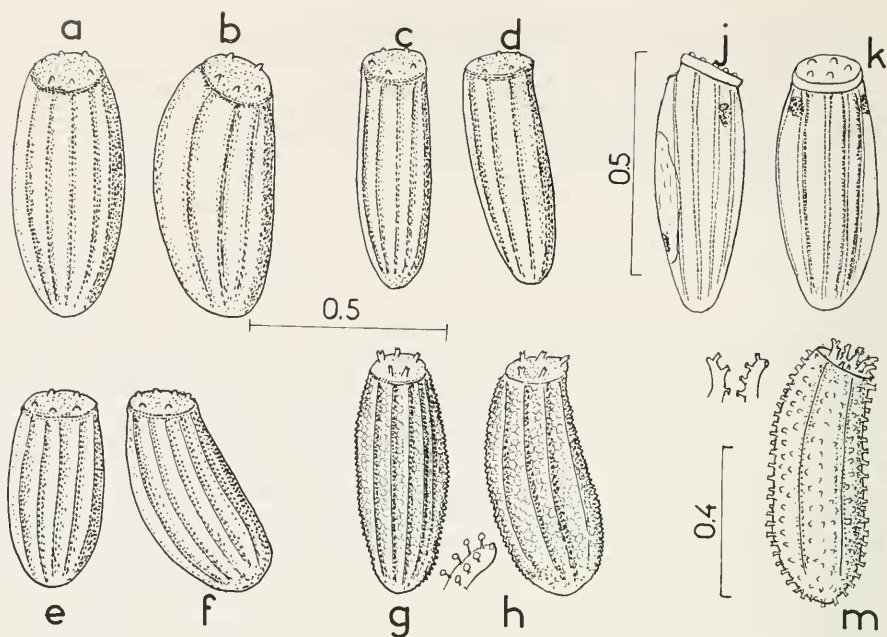


Fig. 10: Eggs of different *Piesma*. — a, b, *P. salsolae*; c, d, *P. maculatum*; e, f, *P. kolenatii atriplicis*; g, h, *P. kochiae*; j, k, *P. variable*; m, *P. josifovi*. — Scale in mm. — (a–h, after PUTSHKOV, 1974; j, k, Original; m, after LEE & PARK 1971).

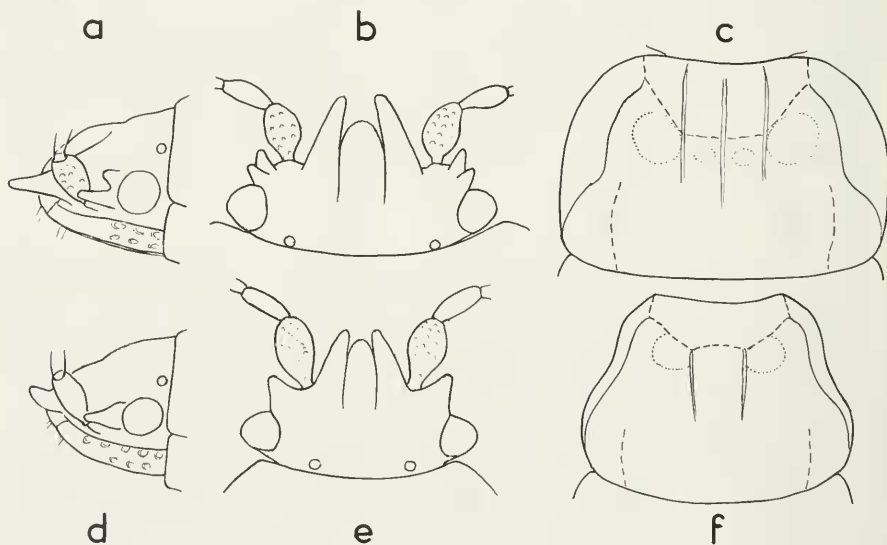


Fig. 11: Head and pronotum of *Piesma* s. str. and *Parapiesma*. — a, head of *P. (Parapiesma) quadratum* ♀, lateral view; b, id., dorsal view; c, pronotum of the same species; d, head of *P. (Piesma) capitatum* ♀, lateral view; e, id., dorsal view; f, pronotum of the same species. — (after PÉRICART, 1974).



Eggs without operculum (of pentatomorphan type), their anterior pole truncate, bearing 4 to 8 aero-micropylar cups. Nymphs more or less oval with short legs and antennae, general coloration greenish, two dorso-abdominal scent glands present.

Phytophagous insects, sucking the sap of various plants which in the Palaearctic realm belong to the families *Chenopodiaceae* and *Caryophyllaceae*.

About thirty species are known to date, belonging to this genus, half of them from the Palaearctics, about one fourth from the Ethiopian and Indomalayan realms, and one fourth from Nearctics, respectively.

Systematics. *Piesma* represents an homogenous genus. The study of the external morphology and that of the female spermatheca lead to dividing it into three subgenera. Two of them, *Piesma* s. str. and *Parapiesma* are present in the Palaearctics. The characters of these subgenera will be given later. Identification of subgenera is not difficult, as their main characters are the form of preocular tubercles and the number of pronotal carinae (see figures 11 a–f). In contrary, the identification on the species level, namely of the subgenus *Parapiesma*, is rather difficult due to the variability of nearly all distinguishing characters.

#### Key to species. Adults.

- 1 ( 6) Disc of pronotum bicarinate (fig. 11f), preocular tubercles single, subconical (figs. 11d, e) . . . . . Subgen. 1.—*Piesma* s. str. . . . . 2
- 2 ( 3) Jugal short and blunt, only slightly reaching beyond the apex of clypeus; the latter long, extending to the posterior margin of the eyes (figs. 18a, b, d). First antennal segment and tibiae with prominent tubercles. Metasternum narrow (fig. 18c). Submacropterous. Length: 2.4–2.7 mm. Reported only from Southern China . . . 3.—*xishaenum* HSIAO et JING p. 109
- 3 ( 2) Jugal long, digitiform or with converging, pointed apices (figs. 14a, 16a–e); clypeus shorter; first antennal segment and tibiae only with coarse granules. Metasternum wider . . . . . 4
- 4 ( 5) Frons strongly and uniformly convex between the eyes (fig. 14c, f); marginal laminae of pronotum narrow with one distinct row of areolae, sometimes doubled anteriorly. Jugal digitiform, straight, very long in male (figs. 14a, b, c) or rather short in female (figs. 14d, e). Coloration mostly uniform, rarely with darker spots. Macropterous or brachypterous. Length: macr. 2.4–2.8 mm, brach. 2.1–2.5 mm. Species of Euro-Siberian distribution, living on *Chenopodiaceae* . . . . . 1.—*capitatum* (WOLFF) p. 101
- 5 ( 4) Frons slightly convex between the eyes, laterally flattened or concave (figs. 16e, f); marginal laminae of pronotum wider, usually two distinct rows of areolae, rarely one or three rows anteriorly. Jugal converging anteriorly, less differing in shape between the sexes (figs. 16a–d). Hemelytra with variable darker spots, sometimes unicolor (f. *viridis* JAKOVLEV). Macropterous or submacropterous. Length: 2.2–3.5 mm. Species of Euro-Siberian and Mediterranean distribution, living on *Chenopodiaceae* . . . . . 2.—*maculatum* (LAPORTE) p. 104

- 6 ( 1) Disc of pronotum tricarinate or with five carinae<sup>9</sup> (fig. 11c), preocular tubercles double (figs. 11a, b) . . . . . Subgen. 2.—*Parapiesma* . . . . . 7
- 7 (10) Disc of pronotum with five prominent longitudinal carinae, the two lateral ones not reaching anterior and posterior margin of pronotum as do the remaining ones. Marginal laminae of pronotum anteriorly of nearly equal width as posteriorly. Main hemelytral veins forming carinae. Metasternum narrow (fig. 44d) . . . . . 8
- 8 ( 9) Antennae shorter, third segment 0.45–0.53 times as long as the diatone, juga subparallel, surpassing the clypeus by 1.0 times the length of the eye. Brachypterous, very rarely macropterous. Length: brach. 1.5–2.4 mm, macr. 2.3–2.75 mm. Subspecies distributed in the Russian Middle Asian steppic regions, reaching even Central Europe. Lives on *Chenopodiaceae* of the genus *Kochia* . . . . . 15a.—*kochiae kochiae* (BECKER) p. 153
- 9 ( 8) Antennae longer, third segment 0.6–0.65 times as long as the diatone, juga longer, surpassing the clypeus by 1.2 times the length of the eye. Brachypterous. Length: 2.17–2.66 mm. Reported only from China . . . . . 15b.—*kochiae longicarinum* HSIAO et JING p. 156
- 10 ( 7) Species not sharing this combination of characters. Disc of pronotum with three distinct carinae, sometimes an additional one is slightly developed on each side laterally . . . . . 11
- 11 (12) Lateral margins of pronotum rounded or nearly straight but never sinuate. Marginal laminae of pronotum wide, with 3 to 4 rows of areolae on their anterior  $\frac{2}{3}$ . Pronotal carinae at least obliterated at posterior  $\frac{1}{3}$ . Macropterous or submacropterous, very variable in color and shape. Length: 2.6–3.4 mm. Species of Euro-Mediterranean-Asiatic distribution, living on *Chenopodiaceae* of littoral and saline areas . . . . . 4.—*quadratum* (FIEBER) p. 111
- 12 (11) Lateral margins of pronotum at least slightly sinuate at middle . . . . . 13
- 13 (14) Small slender species of uniform pale greenish-yellow color, metasternum at least as wide as long (fig. 35l), third antennal segment 0.5–0.6 times as long as the diatone, pronotal carinae at most visible on the anterior  $\frac{2}{3}$  of disc. Macropterous or brachypterous. Length: 1.6–1.8 mm. Reported from Irak, Arabia and Middle Asia . . . . . 10.—*tenellum* HORVÁTH p. 137
- 14 (13) Species not sharing this combination of characters . . . . . 15
- 15 (28) Pronotal carinae at most visible on the anterior  $\frac{2}{3}$  of disc . . . . . 16
- 16 (19) Marginal laminae of pronotum with two rows of areolae, at least on their anterior half . . . . . 17
- 17 (18) Macropterous, third antennal segment 0.4–0.5 times as long as the diatone (fig. 40a), pronotum more converging anteriorly, in profile with rounded anterior lobe and distinct depression (fig. 40b), metasternum longer than wide. Length: 2.3–2.5 mm. Subspecies distributed from Balcan Peninsula to Southern Russia and Middle Asia . . . . . see 11b.—*kolenatii atriplicis* (FIEBER) f. macr. p. 142

9 The median carina is not always distinct.

- 18 (17) Macropterous to submacropterous, third antennal segment relatively longer, 0.5–0.55 times as long as the diatone (fig. 40c), pronotum more expanded anterolaterally and in profile with flat anterior lobe and slight depression (figs. 40d), metasternum as wide as (submacr.) or wider than its length (photo 2). Length: 2.3–3.0 mm (macr.), 2.0–2.3 mm (submacr.). Species distributed in Central Asia, Mongolia, living on *Chenopodiaceae*. . . . . 12.–*kerzhneri* n. sp. p. 146
- 19 (16) Marginal laminae of pronotum narrow, only one row of areolae distinct, sometimes with some additional areolae anteriorly . . . . . 20
- 20 (21) Third antennal segment 0.5–0.6 times as long as the diatone. Metasternum equal in length and width (fig. 24e). Disc of pronotum gibbously elevated posteriorly, flattened toward anterior margin, in profile nearly straight on anterior  $\frac{2}{3}$  (fig. 25b). Only macropterous form known. Length: 2.6–3.5 mm. Species of Euro-Siberian distribution, living on *Chenopodiaceae* of the genus *Salsola* . . . . . 5.–*salsolae* (BECKER) p. 119
- 21 (20) Species not sharing this combination of characters. Third antennal segment at most 0.45 times as long as the diatone. Metasternum usually longer than its width (figs. 26g, 29d, 35f, 39e, 42e). Living on *Caryophyllaceae* . . . . . 22
- 22 (27) Surface shiny; hemelytral membrane more or less developed but always visible; third antennal segment at least as long as fourth; part of juga projecting beyond clypeus at least as long as length of eye. Macropterous or submacropterous, never brachypterous . . . . . 23
- 23 (24) Pronotum seen in profile only slightly convex and slightly sloping anteriorly even in macropterous forms (fig. 30b). Pronotum posteriorly rarely of light color, usually dark, anterior  $\frac{1}{3}$  always light colored. Third antennal segment 0.35–0.45 times as long as the diatone, and 1.0–1.2 times as long as fourth segment. Macropterous to submacropterous. Length: 2–2.75 mm. Species distributed in Europe and Middle East, living on *Dianthus*, *Silene* and related genera . . . . . 7.–*silenes* (HORVATH) p. 128
- 24 (23) Pronotum seen in profile gibbously elevated posteriorly, evenly sloping to anterior margin (figs. 27c, 32c). General color light without remarkable contrasts, or uniformly brown . . . . . 25
- 25 (26) Third antennal segment 0.35–0.45 times as long as the diatone and 1.15–1.30 times as long as the fourth segment. Anterior part of pronotal carinae usually distinct. Color variable, mostly with brownish, not very contrasting, spots. Larger species. Length: 2.25–2.90 mm. Species of European-Middle Asian distribution, living on *Herniaria* . . . . . 6.–*variabile* (FIEBER) p. 123
- 26 (25) Third antennal segment only  $\frac{1}{3}$  as long as the diatone and about equal in length to the fourth segment. Pronotal carinae very short and sometimes hardly discernible. Color almost uniformly greenish-brown to reddish-brown. Length: 2.1–2.65 mm. Species discovered in Norway, living on *Silene* . . . . . 8.–*unicolor* WÄGNER p. 131
- 27 (22) Surface almost mat. Brachypterous (without membrane) or rarely macropterous. Third antennal segment 0.9–1.0 times as long as the fourth segment. Length: macr. 2.25–2.50 mm, brach. 1.80–2.20 mm. Species of

- Western-Mediterranean distribution, living on *Herniaria* . . . . . 9.-*pupula* PUTON p. 134
- 28 (15) At least median pronotal carina visible up to the posterior margin . . . . . 29
- 29 (30) Only median pronotal carina visible up to the posterior margin, marginal laminae with 3 rows of areolae on anterior  $\frac{1}{2}$ ; third antennal segment 0.85 times as long as the diatone and about 2 times as long as the fourth segment. Macropterous. Length: 3.27 mm. Known only by holotype ♀ from Peking . . . . . 13.-*bificeps* HSIAO ET JING p. 149
- 30 (29) All three pronotal carinae visible up to the posterior margin . . . . . 31
- 31 (32) Antennae long, third segment as long as about  $\frac{2}{3}$  of the diatone. Lateral margin of pronotum distinctly sinuate at middle; marginal laminae uniseriate on posterior  $\frac{2}{3}$ . Metasternum narrow (fig. 42e). Brachypterous, rarely macropterous. Length: 2.4–2.9 mm (brach.), 2.9–3.2 mm (macr.). Species of Far East distribution . . . . . 14.-*josifovi* PÉRICART p. 150
- 32 (31) Antennae shorter, species not sharing these characters . . . . . 33
- 33 (34) Marginal laminae of pronotum very narrow, uniseriate even anteriorly, their width on anterior  $\frac{1}{3}$  about  $\frac{1}{2}$  of the distance between median and lateral pronotal carinae. Antennae short, third segment no longer than  $\frac{1}{3}$  of the diatone and equal in length to the fourth segment. Brachypterous (without membrane). Length: 1.8–2.1 mm . . . . . see 9.-*pupula* PUTON (f. brach.) p. 134
- 34 (33) Marginal laminae of pronotum wider, with two rows of areolae at least on the anterior  $\frac{1}{3}$  . . . . . 35
- 35 (36) Marginal laminae of pronotum with three rows of areolae. Antennae relatively long, third segment 0.5 times as long as the diatone. Macropterous or brachypterous. Length: macr. 2.75 mm, brach. 2–2.35 mm. Subspecies known only from Caucasus and Eastern Anatolia . . . . . 11a.-*kolenatii kolenatii* (FIEBER) p. 141
- 36 (35) Marginal laminae of pronotum only with two rows of areolae anteriorly. Size smaller . . . . . 37
- 37 (38) Macropterous or brachypterous. Third antennal segment 0.33–0.48 times as long as the diatone. Length: macr. 2–2.5 mm, brach. 1.6–2.1 mm. Subspecies distributed from Southern Mediterranean countries to Canary Islands, Middle East . . . . . 11c.-*kolenatii rotundatum* HORVATH p. 145
- 38 (37) Macropterous to subbrachypterous, at least a small border of membrane always present. Third antennal segment 0.4–0.5 times as long as the diatone. Length: macr. 2.3–2.5 mm, subbrach. 1.25–2.3 mm. Subspecies distributed on Balcan Peninsula, Southern Russia, Middle East . . . . . 11b.-*kolenatii atriplicis* FREY-GESSNER p. 142

Note: *Piesma distans* DRAKE, 1940, was described on specimens from Bombay, India. This species is characterized by its short and blunt juga, which are not reaching beyond the clypeus, and anteriorly dilated lateral margins. These characters are common to African species to which it is closely related and perhaps synonym of one of the described species. It does not belong to the Palearctic fauna. (Holotype ♂ and allotype ♀, M. Vi.!).

## Key to known last instar nymphs

- 1 (14) Dorsal body surface finely shagreenate without granules or spiniform tubercles (sometimes a few small tubercles are present along the median longitudinal line of the abdomen) . . . . . 2
- 2 ( 3) Preocular tubercles single (fig. 17c). Pronotum, mesonotum and hemelytral lobes usually with clearly visible blackish striolae (subg. *Piesma* s. str.) . . . . . *capitatum* (WOLFF) p. 101  
and *maculatum* (LAPORTE) p. 104
- 3 ( 2) Preocular tubercles double<sup>10</sup>. Body greenish, nearly unicolor or abdomen reddish at scent glands and genital segment (subg. *Parapiesma* PÉRICART) . . . . . 4
- 4 (11) Without tubercles on the median longitudinal line of the abdomen . . . . . 5
- 5 (10) Larger nymphs: at least 1.8 mm; third antennal segment at least 0.8 times as long as fourth segment . . . . . 6
- 6 ( 7) Jugs anteriorly curved against each other, touching each other in males (figs. 9a, b). . . . . *quadratum* (FIEBER) p. 111
- 7 ( 6) Jugs anteriorly straight, in male as long or only slightly longer than clypeus, in female shorter (figs. 9c, d, e, f) . . . . . 8
- 8 ( 9) Third antennal segment 1.1–1.2 times as long as the fourth segment (fig. 9e). Larger than the following: 2.0–2.7 mm . . *salsolae* (BECKER) p. 119
- 9 ( 8) Third antennal segment 0.8–0.9 times as long as the fourth segment. Length: 1.8–2.3 mm . . . . . *variabile* (FIEBER) p. 123
- 10 ( 5) Smaller nymphs: at most 1.8 mm; third antennal segment 0.6–0.7 times as long as the fourth segment . . . . . *silenes* (HORVÁTH) p. 128
- 11 ( 4) A small tubercle is present on tergites I to VIII each along the median longitudinal line . . . . . 12
- 12 (13) Third antennal segment only  $\frac{2}{3}$  as long as fourth segment. Length: 1.6–1.8 mm . . . . . *pupula* PUTON p. 134
- 13 (12) Third antennal segment as long as fourth segment. Length: 2.0–2.5 mm . . . . . *josifovi* PÉRICART p. 150
- 14 ( 1) Dorsal body surface covered with granules or tubercles . . . . . 15
- 15 (16) Tibiae bearing rows of 3–4 tubercles about half as long as tibial diameter; lateral margins of pronotum appearing denticulate, with 5–6 well developed tubercles (figs 36c, d) . . . . . *tenellum* HORVÁTH p. 137
- 16 (15) Tibiae with very tenuous or without tubercles; lateral margins of pronotum not or only finely denticulate . . . . . 17
- 17 (18) Median dorsal carina of pronotum not lowered at its middle; width of marginal laminae not enlarged anteriorly . . . . . *kochiae* (BECKER) p. 153
- 18 (17) Median dorsal carina vanishing at middle; anterior part of marginal laminae well enlarged . . . . . *kolenatii* (FIEBER) p. 141

10 Look at the nymph from above. The anterior preocular tubercle is more pointed than the posterior one and sometimes projects anteriorly; the posterior tubercle is near the inner border of the eye which sometimes slightly conceals it.



Key to nymphal instars

- 1 ( 4) Mesonotum and metanotum without posterior lobes . . . . . 2
- 2 ( 3) Claws not present but parempodia of tarsi developed. Eyes composed of only about ten facets (fig. 7a) . . . . . first instar<sup>11</sup>
- 3 ( 2) Claws developed. Eyes composed of numerous facets (fig. 7b) . . . . . second instar
- 4 ( 1) Mesonotum at least sinuate posteriorly or with hemelytral lobes . . . . . 5
- 5 ( 6) Only hind margin of mesonotum sinuate laterally (fig. 7c) . . . . . third instar
- 6 ( 5) Mesonotum with hemelytral lobes at least as long as half of its basal width; metanotum with alary lobes partly covered by the first . . . . . 7
- 7 ( 8) Hemelytral lobes not longer than its width, at most reaching posterior margin of abdominal tergite II (figs. 17b, 9d) . . . . . fourth instar
- 8 ( 7) Hemelytral lobes at least two times as long as its width, reaching or surpassing the anterior margin of abdominal tergite IV . . . . . fifth instar

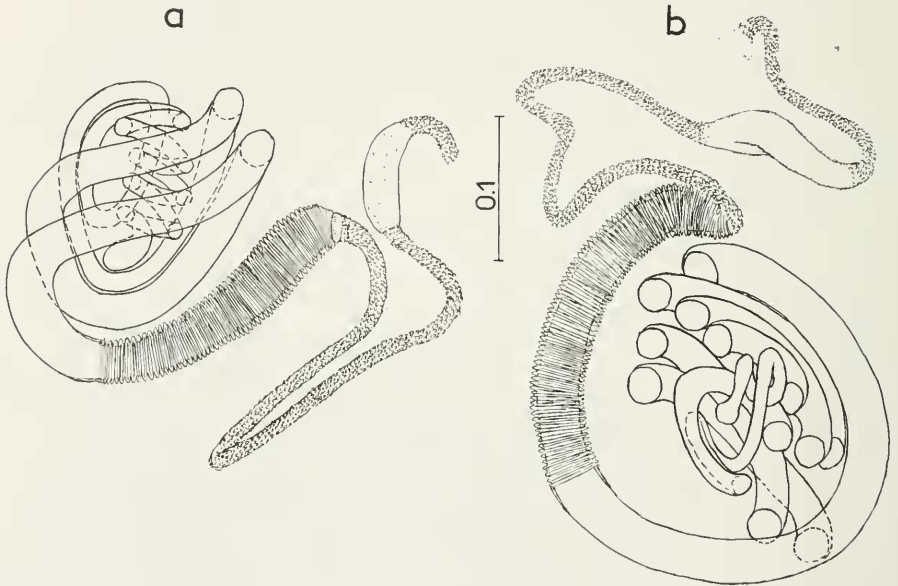


Fig. 12: Spermatheca of female *Piesma* s. str. and *Parapiesma*. – a, *P. (Piesma) maculatum*; b, *P. (Parapiesma) variable*, (loops of spirals are partly cut to show the small terminal helix). – Scale in mm. – (after PÉRICART, 1974).

11 These characters have been studied only in *P. variable*, therefore their validity for the whole genus is not strongly stabilised.

## Subgenus 1: *Piesma* s. str. Le PELETIER & SERVILLE

Type species: *Acanthia capitata* WOLFF, 1804

*Piesma* s. str. PÉRICART, 1974: 53

Adults. – Preocular tubercles single, conical (figs. 11 d, e). Pronotum not having a median longitudinal carina but one laterally on each side, which extends posteriorly (fig. 11 f). Female: Coiled part of spermatheca relatively short, consisting of 2 to 3 concentric rings and a small terminal spiral with 4 to 6 whorles (fig. 12 a).

Subgenus comprising about fifteen species which are represented in the Palaearctic, Nearctic, Ethiopian and Indo-Malayan<sup>12</sup> realms.

Nymphs (fifth instar). – Preocular tubercles single.

### 1. *Piesma* (s. str.) *capitatum* (WOLFF, 1804)

*capitata* WOLFF, 1804: 131 (*Acanthia*) neotype (♂ macr., Austria) M. Pa!; – *collaris* ZETTERSTEDT, 1828: 481 (*Tingis*) lectotype (♂ brach., Scandinavia) M. Lu!; – *pedicularis* HERRICH-SCHAEFFER, 1830: 118, tab. 19 (*Tingis*) type (brach., Germany) lost; – *maculatum* sensu COSTA, 1847: 21, pl. 3, fig. 4<sup>13</sup> (nec LAPORTE, 1833); – *stephensi* FIEBER, 1844: 35, tab. II fig. 20–21 (*Zosmenus*) type ? (brach. Bohemia); – *antica* sensu FIEBER, 1844 l. c. (nec STEPHENS, 1829) (*Tingis*) (brach.); – *pallidum* COSTA, 1862: 36 pl. 1, fig. 8–9, type ? (Southern Italy); – *capitatum* var. *declivis* REY, 1893: 97, holotype (♂ brach., France) M. Ly!; – *capitatum* var. *divergens* REY, 1893: 97, lectotype (♂ brach., France) M. Ly!.

HORVÁTH 1906: 4; MAYER 1940: 251; STICHEL 1957: 35; ŠTYS 1963: 301; HEISS 1972: 66; PUTSHKOV 1974: 61; HEISS & PÉRICART 1975: 520 (synonymies, lectotypes), *ibid.*: 534 (neotype).

Adults. – General shape: macr. fig. 13 a, brach. fig. 13 b. Macropterous or brachypterous, very rarely submacropterous. Preocular tubercles single; juga of males digitiform, subparallel or slightly converging anteriorly, its projecting part beyond clypeus almost as long as the length of the eye (figs. 14 a, b); in females considerably shorter (figs. 14 d, e). Frons strongly and uniformly convex between the eyes (figs. 14 c, f). Color of head variable, sometimes with darker clypeus and ocellar region, sometimes the whole frons or the whole head except the anterior projections of the juga are brownish or black. Antennae unicolor stramineous to fuscous, as long as the pronotum (macr.) or 1.1–1.25 times as long (brach.), third segment 0.4–0.5 times as long as the fourth segment. Rostrum reaching slightly beyond procoxae. Disc of pronotum bicarinate on the anterior half, margi-

12 During completion and correction of the indications given by PÉRICART (1974 l. c.) it was possible to check the concerned material at the U. S. National Museum (Washington D. C.) and it is confirmed now: *P. dilutum* (STAL), an Ethiopian element, belongs to *Piesma* s. str.; *P. distans* DRAKE (Indo-Malayan) and *P. patruale* MCATEE (Nearctic), previously mentioned under "*Piesma* incertae sedis" also belong to *Piesma* s. str.

13 The dates of COSTA's publications have been discussed by several authors, most recently by KERZHNER (1974). Those cited above concern separate editions which have been published later than the generally mentioned ones, basing on the deposition of the manuscripts, but earlier or at the same time than the publication in the periodical "Atti r. ist. incoragg. sci. nat. Napoli". The years cited by HEISS & PÉRICART (1975) are those of the manuscripts, but concerning *P. maculatum* sensu COSTA, the reference was inaccurate.

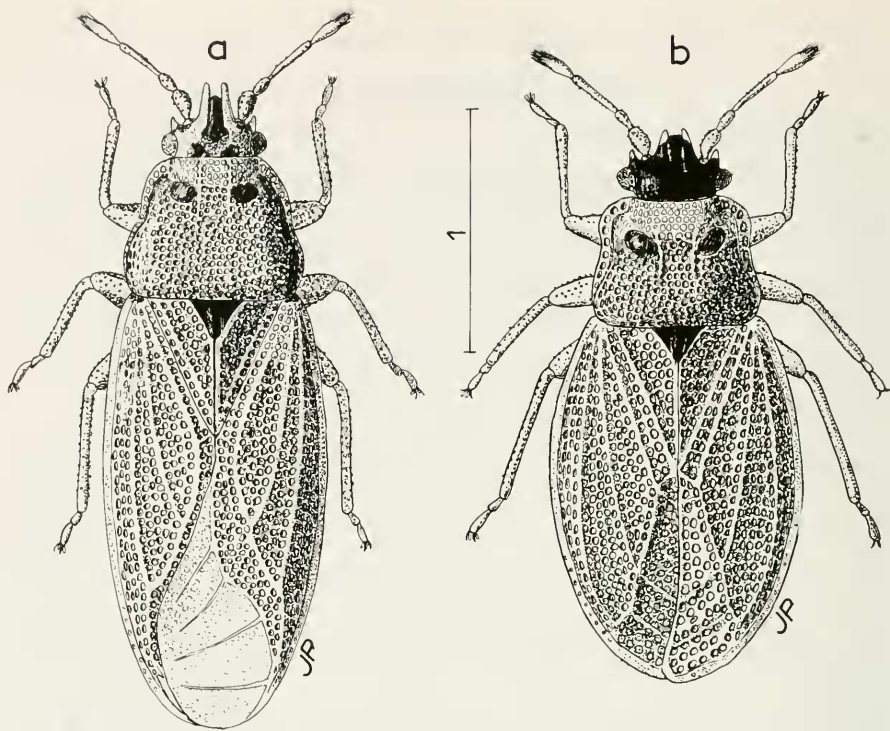


Fig. 13: *Piesma capitatum*. – a, macropterous ♂; b, brachypterous ♀. – Scale in mm. – (Original).

nal laminae narrow, usually with only one complete row of areolae, sometimes a second incomplete row is present; lateral margins always clearly sinuate at middle, constricted anteriorly; anterior callosities usually darker, the posterior margin of pronotum sometimes brownish. Hemelytra of macropterous form 1.6–1.75 times as long as their maximum width and extending distinctly beyond apex of abdomen; those of brachypterous form 1.45–1.55 times as long as its width, without membrane, slightly longer than the abdomen. Color of hemelytra usually light, sometimes whitish anterolaterally. Posterior wings of brachypterous form reduced to rudiments. Femora, tibiae and tarsi yellowish to reddish. Male parameres figs. 14 g, h.

Length: 2.4–2.8 mm, brach. 2.1–2.5 mm; antennal segments I: II: III: IV = 0.10–0.14: 0.08–0.13: 0.20–0.27: 0.18–0.23 mm; rostral segments I: II: III: IV = 0.20: 0.20: 0.10: 0.29 mm.

Width: across hemelytra 0.95–1.10 mm.

Immature stages. – According to MAYER (1940) and PUTSHKOV (1974) they are very similar to those of *P. maculatum* (see p. 106). However, it is possible that the study of the shape of the jugs may reveal characters allowing differentiation of at least the last instar nymphs of both species.

Ecology. – This species lives in somewhat humid environments, fallows, roadsides and borders of cultivated areas where it develops primarily on *Chenopodiaceae*. It has been

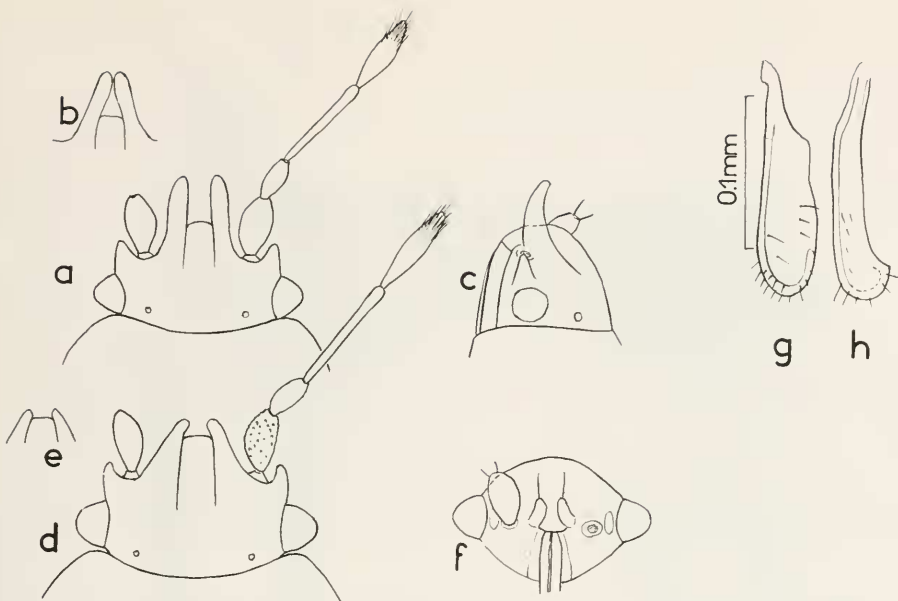


Fig. 14: *Piesma capitatum*. – a, ♂, head, dorsal view; b, ♂, jugal appendices of another specimen; c, head, lateral view; d, ♀, head, dorsal view; e, id., other specimen; f, id., head, anterior view; g, h, paramere, ventral and lateral view. – (Original).

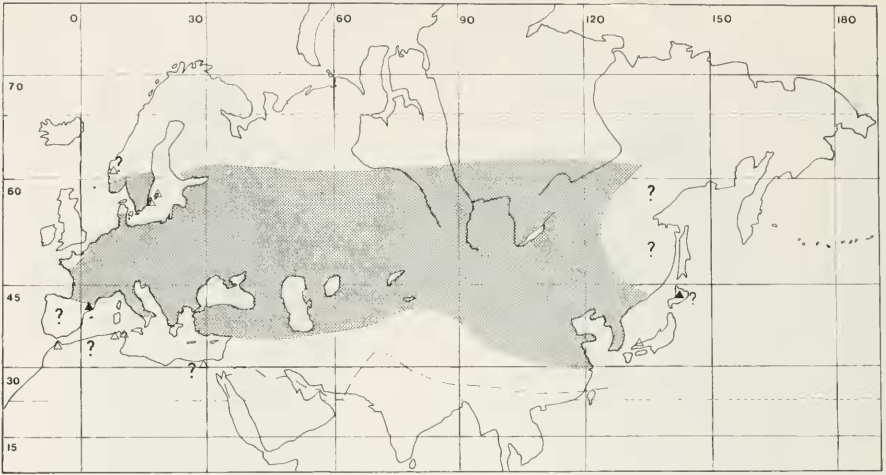
recorded from *Chenopodium polyspermum* L. (FIEBER, 1861), *Ch. album* L. (several observations), also from *Ch. hybridum* L. (EHANNO leg., in Brittany/France), and its development is probably possible not only on other species of this genus, but also on closely related genera, as well. It was also mentioned from *Caryophyllaceae* (*Spergula*), *Scrophulariaceae* (*Verbascum*) and *Lamiaceae* (*Ballota*) and these indications seem not to be merely coincidental, as R. REMANE (pers. comm.) has collected this species in Germany near Mainz on *Ballota nigra* L.; the presence of numerous brachypterous specimens in this population seemed to prove that it was not a merely transitional host plant.

The capture of macropterous specimens on trees possibly corresponds to phases of minor migrations.

The yearly life-cycle of *Piesma capitatum* is not known with certainty mainly due to multiple confusions with the very common and closely related *P. maculatum*; probably both species have a similar life cycle. The adults hibernate beneath litter and detritus and are found in phase of activity during the remaining period of the year.

*Piesma capitatum* has been considered repeatedly, notably in Russia, to be a pest of the sugar beet (*Beta vulgaris* L.) (VASILEV 1911, ZVEROZOMB-ZUBOVSKIY 1928, BRUNNER 1954). According to PUTSHKOV it might be attracted by weeds like *Chenopodium* or *Amaranthus*, but in no case have noteworthy damages been reported; moreover, this species cannot transmit the virus disease of sugar beets spread by *P. quadratum*.

Distribution. – (Map 1) *Piesma capitatum* is an Euro-Siberian element occurring nearly throughout the whole belt ranging west to east across the Palaearctics and limited in the north by the 61st parallel, south by the Northern Mediterranean coast up to the Gulf of



Map 1: Palearctic distribution of *Piesma capitatum*. The question marks indicate the regions where the presence of this species is uncertain.

Iskenderun, the northern boundary of Syria, the southern limits of Russian Central Asia through Kirghizistan, followed up by the southern limits of Palearctic China. It is not so common as *P. maculatum* at least in the Western Palearctic region and its distributional pattern shows some gaps, also some uncertain records due to numerous confusions with *P. maculatum* in the literature.

It seems to be absent in Great Britain. In France, it is rare or absent in Normandy and the northern provinces (confused by ancient authors with *P. maculatum*!). Present in Belgium (BOSMANS & PÉRICART 1982). Very rare or possibly absent in the Netherlands (confusions by authors!) From Spain it is known only from Val d'Aran and Catalonia (!); its presence in Portugal is to be verified. It seems to be absent in Southern Italy (Puglia, Calabria), Corsica, Sardinia and Sicily; not recorded from Peloponnesian Peninsula. Rare in Anatolia: Afyon!, Kocaeli, Ankara!, Kars!, South of the Mediterranean Basin; it is reported from Morocco (Tanger, Melilla), from Algeria (Annaba), from Tunisia and Egypt, but all these references have to be confirmed. In Scandinavia, it seems to reach from 60th to the 61st degree North (Karelia!). Distribution is poorly known in Caucasia, Transcaucasia and Russian Central Asia as well as in Eastern Palearctic region. Siberia: Tobolsk, Novosibirsk, Yeniseysk, Tungusk, Irkutsk, Yakutsk (Olekminsk), Altai Mountains; Mongolia: (HORVÁTH 1906, HOBELANDT 1974), Central Aimak (KERZHNER leg. M. Le.!); China: Sinkiang, Szechuan, Gansu, Tianjin!, Hubei! (HSIAO et JING 1979); North Korea (Pjöngyang!); South Korea (Taegu, Song-gae Weolacksan, leg. LEE!); Japan: Hokkaido! is a doubtful locality, as the second record (Hagi, Jamaguchi Pref., sec. SHIRAKI 1954) is another species and no true *P. capitatum* has been seen from Japan (TOMOKUNI pers. comm.).

Remarkable is the fact that the populations of Northern Europe (Sweden, Finland) are almost exclusively brachypterous (!).

## 2. *Piesma* (s. str.) *maculatum* (LAPORTE DE CASTELNAU, 1833)

*capitata* sensu FALLÉN, 1807: 40, 12 (*Tingis*) (nec WOLFF, 1804); – *antica* STEPHENS, 1829: 336 (*Tingis*) type? (Great Britain); – *maculatus* LAPORTE DE CASTELNAU, 1833: 49 (*Zosmenus*) neotype (♂, France) M. Pa!; – *laportei* FIEBER, 1844: 33 (*Zosmenus*) lecto-



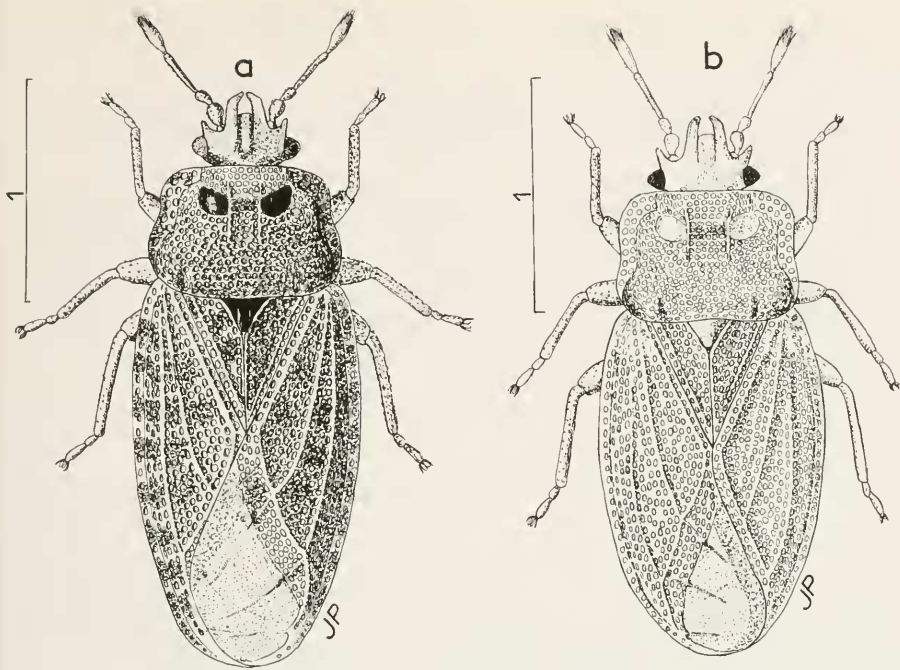


Fig. 15: a, *Piesma maculatum* ♂ (France); b, id., "f. *viridis*" ♀ (Russia: Lower-Volga). – Scale in mm. – (Original).

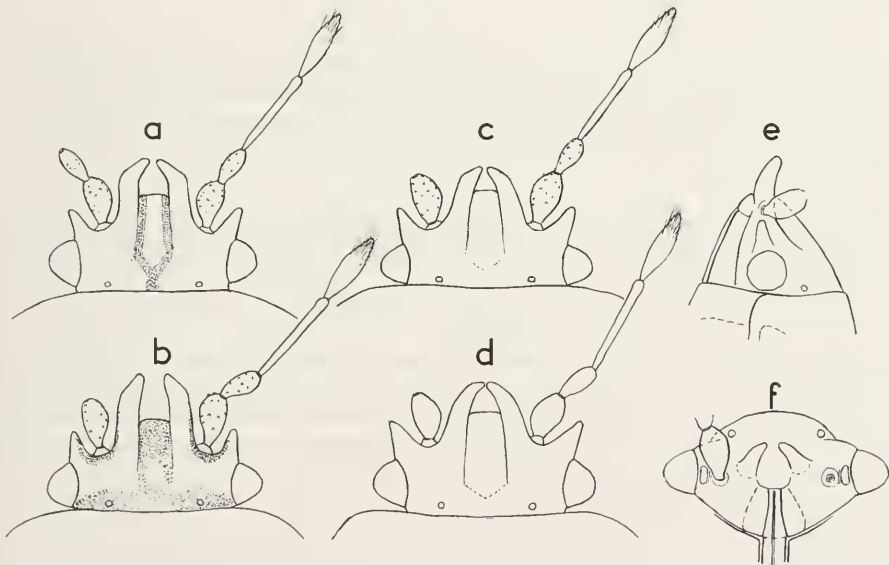


Fig. 16: Head of *Piesma maculatum*. – a, b, e, f, males; c, d, females; e, lateral view; f, anterior view. – (Original).

type (♂, Europe) M. Pal.; – *viridis* JAKOVLEV, 1871: 7 (*Zosmenus*) lectotype (♀, Astrachan) M. Le!.

HORVÁTH 1906: 5; MAYER 1940: 251; STICHEL 1957: 35; ŠTYS 1963: 301; LEE & PARK 1971: 1; PUTSHKOV 1974: 60; HEISS & PÉRICART 1975: 521 (synonymies, lectotypes), *ibid.*: 535 (neotype).

Adults. – General shape: macr. fig. 15 a, submacr. fig. 15 b. Macropterous to submacropterous.<sup>14</sup> Preocular tubercles single; juga long, strongly converging anteriorly, frequently contiguous at apex, surpassing clypeus by 1.0–1.25 the length of the eye in male and less in female (figs. 16 a, b, c, d); frons slightly convex between the eyes, laterally flattened or concave (figs. 16 e, f). Color of head variable, sometimes entirely light, more frequent at least lateral margins of clypeus and the ocellar region brownish; this color may extend to the whole head including antennae; rostrum and antennae as in *P. capitatum*. Disc of pronotum bicarinate on the anterior half, marginal laminae almost with one complete row of areolae, mostly a second incomplete row or rarely traces of a third row are present anteriorly; lateral margins sinuate at middle; color variable from uniformly light to brownish, the anterior callosities darker.

Hemelytra 1.2–1.75 (mostly 1.5–1.6) times as long as their maximum width, extending distinctly beyond apex of abdomen, membrane always present; color yellowish–grey or greenish, usually with irregular brown spots on corium and costal laminae, rarely unicolorous, in all cases the anterolateral angle of corium remains light, frequently whitish.

Length: 2.2–3.15 mm, width across hemelytra 0.95–1.30 mm. The smallest dimensions are taken from submacropterous specimens. The form *viridis*, which refers to submacropterous uniformly greenish specimens, has no taxonomic importance.

Closely related but clearly distinct from *P. capitatum*, which can be separated by the characters indicated in the key, of which the shape of frons is certainly the most reliable distinguishing character.

Egg. – (figs. 10 c, d). Referring to MAYER (1940), COBBEN (1968) and LEE & PARK (1971). Yellowish when freshly deposited, later becoming darker. Relatively elongate, about three times as long as its diameter. Chorion very finely reticulate, marked by at least five longitudinal carinae which obliterate before the poles. The truncate cephalic pole shows 4–8 micropylar processes arranged in the form of a crown. Length: 0.53 mm; width: 0.19 mm.

Immature stages. – Referring to the same authors and own observations of nymphal instars of fourth and fifth stage found in France. Ovate, depressed. Body pale greenish to yellowish-green, eyes red.

Dorso-abdominal glands reddish, visible as a round spot in the middle of tergite IV, more or less extending to tergites III and V.

Third instar (fig. 17 a). Juga shorter than clypeus. Preocular tubercles already visible. Antennae whitish, as long as the diatone; relative length of segments I: II: III: IV = 3: 2.5: 4: 6. Rostrum reaching the anterior  $\frac{1}{3}$  of metasternum, relative length of segments I: II: III: IV = 5: 3: 2: 6. Posterior margin of mesonotum and metanotum almost straight, hemelytral and alar lobes not yet developed. Legs whitish.

Length: 1.0–1.2 mm; width: 0.55–0.65 mm.

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14 Due to a confusion with *P. capitatum* by former authors, a brachypterous form has been attributed to *P. maculatum*.

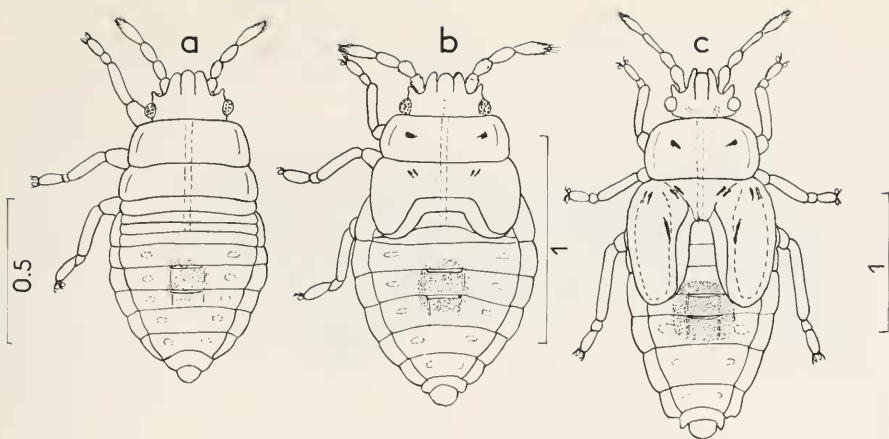


Fig. 17: Nymphal instars III to V of *Piesma maculatum*. – a, instar III; b, instar IV; c, instar V. – Scale in mm. – (Original).

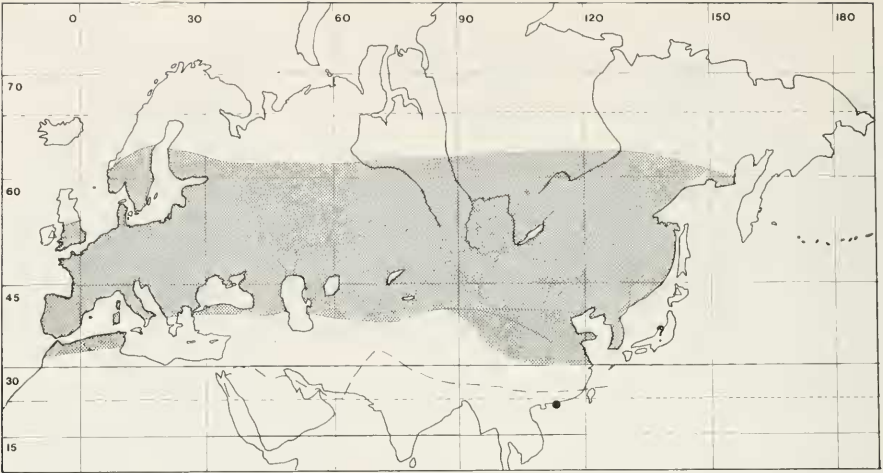
Fourth instar (fig. 17b). Juga slightly longer than clypeus. Antennae whitish-yellow, its fourth segment brownish; relative length of segments I: II: III: IV = 3,5: 3: 5: 7. Rostrum reaching  $\frac{1}{2}$  of mesosternum, relative length of segments I: II: III: IV = 5: 3: 4: 2. Pronotum with two blackish depressions laterally. Hemelytral lobes developed, hardly reaching anterior margin of tergite II, alar lobes developed as well, extending slightly beyond anterior margin of tergite II. Sometimes two pairs of blackish striae are visible on the mesonotum. Legs whitish-yellow, tarsi somewhat darker.

Length: 1.5–2 mm; width: 0.75–0.90 mm.

Fifth instar (fig. 17c). Juga distinctly longer than clypeus by  $\frac{1}{2}$  length of eye in males, or slightly longer in female, which allows to distinguish both sexes. Antennae as long as  $\frac{3}{4}$  of basal width of pronotum, first and fourth segments more or less darkened, relative length of segments I: II: III: IV = 5: 4: 7: 8. Rostrum reaching  $\frac{1}{2}$  of mesosternum, relative length of segments as in fourth instar. Pronotum subrectangular, marginal laminae discernable, anterolateral depressions blackish. Scutellum already delimited with two blackish lines anterolaterally. Hemelytral and alar lobes well developed, the first covering the latter except on its internal margin, reaching  $\frac{2}{3}$  of posterior margin of tergum IV. Blackish striae are visible near the base (2 + 2) and near the internal margin (1 + 1).

Length: 2.2–2.7 mm; width: male 1 mm, female 1.3 mm.

Ecology. – This *Piesma* inhabits somewhat humid localities, roadsides and fallows where *Chenopodiaceae* are frequent; therefore, one can find them in considerably humid environments such as the banks of rivers and marshes also. It is recorded from several *Chenopodiaceae* mainly belonging to the genera *Chenopodium* and *Atriplex*: *Chenopodium album* L., *Ch. acuminatum* WILLD., *Ch. urbicum* L., *Atriplex hastata* L., *A. heterosperma* BUNGE, *A. hortensis* L. It has been mentioned from *Herniaria glabra* L. by SCHOLTZ (1847), which certainly resulted from confusion with *P. variabile*. The other host plants indicated in the literature (*Verbascum*, *Betula*, *Salix*, *Crataegus*, etc.) are only accidental; in particular, the captures from trees concern specimens during change of locality or migration.



Map. 2: Palaearctic distribution of *Piesma maculatum* (dotted area and triangle) and *P. xisbaenum* (circle).

*Piesma maculatum* hibernates as an adult beneath litter and detritus near its host plants. But before that phase, a part of the population undertakes an autumnal migration and one will find them beneath other suitable shelters. According to PUTSHKOV they resume their activities about the middle of April and concentrate on *Chenopodiaceae* where they have developed. In the Ukraine, copulation and oviposition starts in the middle of May and continues to the middle of August without interruption. The first nymphal instars appear at the end of June or at the beginning of July.

The number of generations per year might be from two to three, overlapping considerably.

A few years ago, *Piesma maculatum* was reported to be noxious to sugar beets in Southern Finland (VARIS, 1973). It attacked the very young sprouts, in some cases causing serious damages which have consequently been stopped by plowing. The following treatment with insecticides such as Dimethoate and Parathion has proved effective in most cases.

No transmission of the sugar-beet-disease has been reported from *P. maculatum*.

Distribution (Map 2). — *Piesma maculatum* is nearly an Holopalaearctic element. The northern limits of its distribution reach the 62nd to the 64th degree North in Scandinavia; southern distribution reaches the northern coast of the Mediterranean Sea and the whole region of the Black Sea; it is also present in North Africa (Maghreb) and in Transcaucasia. The southern limit seems then to follow the southern border of Russian Central Asia up to Kirghizia and probably the line delimiting the Palaearctic realm across China.

It is found in Southern and Central Great Britain (up to Yorkshire); mentioned but not confirmed from Eastern Ireland.

Reaches at least 61st degree North in Norway, 64° N in Sweden along the Gulf of Bothnia (Västerbotten) and 62°40' N in Finland, where it is recorded at least in parts of Ostrobothnia, Savonia and Karelia. Very common in Central Europe from France to Russia. In Spain, it is confirmed only from Catalonia, Teruel and Castilia, but probably distributed throughout the country as well as in

Portugal. Its presence is to be confirmed from Southern Italy (Calabria), Sicily and Greece. Known in whole Maghreb from Tunisia to Morocco, but seems to be absent in the Eastern Mediterranean Basin. In Turkey it is recorded only from the coasts of the Black Sea, but is probably distributed elsewhere, too. Its presence, even very rare, is known also in Transcaucasia.

References from Eastern Palaearctics: Siberia: Tobolsk, Yeniseysk, Krasnoyarsk, Irkutsk, Yakutsk, Primorje-province; Tadzhikistan: Tashkent, Alaiskiy Mts.; Kirghizistan: Ferganskiy Mts.; Mongolia: (HORVÁTH 1906), Ulan Bator (JOSIFOV & KERZHNER 1967), Central Aimak, Chentei Aimak, Bulgan Aimak (numerous ex. leg. KASZAB 1965–68, M. Bu!); China: (HSIAO et JING 1979), Tianjin!, Manchuria (DRAKE & MAA 1953), probably of a wider distribution; Korea!; Japan? (Hokkaido: DRAKE & MAA 1953) is doubtful and maybe from Manchuria as well (TOMOKUNI pers. comm.).

The submacropterous form is recorded here and there together with the macropterous form: France!, Yugoslavia!, Hungary!, Austria!, Southern Russia! (type of *viridis*).

### 3. *Pisma* (s. str.) *xishaenum* HSIAO ET JING, 1979

*xishaena* HSIAO ET CHING<sup>15</sup>, 1979: 456 et figs. 4, 5, holotype ♂ and allotype ♀ (Kwangtung, Xisha Is) NHMT, paratype ♀ from same locality!

HSIAO et al. 1981: 218 et figs. 671–673 a, b, table 27 photo 276.

Adults. – General shape: figs. 18a, b. Submacropterous. Yellowish brown with darker clypeus, antennal segments II–IV, posterior half of pronotum, tibiae and tarsi; claws black. Hemelytra with some brownish spots, particularly on the costal laminae. Head short, across the eyes 2.4 times as wide as long; preocular tubercles single; juga short and straight, only slightly surpassing the clypeus. The latter very long, reaching to the posterior margin of eyes. Antennae 1.2 times as long as the diatone, third segment 0.4 times as long as the diatone and 1.1 times as long as the fourth. First segment with prominent tubercles which lack on other segments. Rostrum reaches mesosternum. Pronotum bicarinate, 1.3 times as wide as its median length, the two carinae distinctly developed on anterior half; humeral callosities marked; marginal laminae generally with two rows of areolae, some additional areolae are occasionally present; lateral margins subparallel, slightly sinuate at middle. Hemelytra slightly reaching beyond apex of abdomen; membrane reduced but with distinct veins. Tibiae with two rows of prominent tubercles. Metasternum narrow (fig. 18c), its apex truncate.

Length: 2.4–2.5 mm sec. description, but paratype ♀ is 2.7 mm!, antennal segments I:II:III:IV = 0.11:0.08:0.19:0.17 mm; pronotum 0.68–0.75 mm.

Width: 1.0–1.2 mm across hemelytra; pronotum 0.8–1.0 mm (maximum width), 0.61–0.68 mm anteriorly.

Ecology. – Not indicated in the original description.

Distribution (Map 2). – Up to now, this species is only known from the type locality Xisha Is. in Kwangtung province, Southern China.

This species somewhat resembles *P. maculatum*, but can be distinguished by its short head, long clypeus and short juga, and larger marginal laminae as well as by the prominent granules on first antennal segment and the narrow, truncate metasternum.

15 In the original description, the name of the second author is transcribed as CHING. Later publications (HSIAO et al.) and the author itself (pers. comm.) use the transcription JING, which we followed.



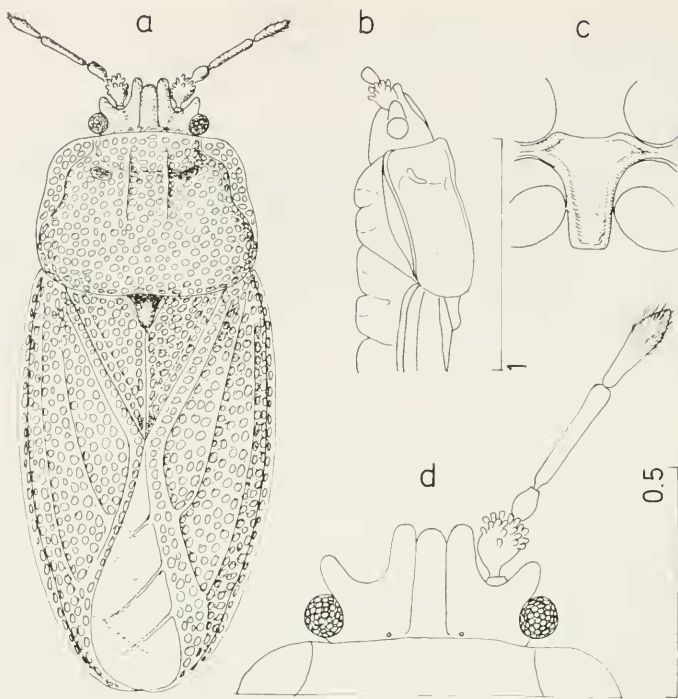


Fig. 18: a-d: *Piesma xisbaenum*. - a, ♀, dorsal view (paratype); b, id., lateral view; c, id., metasternum; d, id., head. - Scale in mm. - (Original).

### Subgenus 2: *Parapiesma* PÉRICART, 1974

Type species: *Tingis cinerea* SAY, 1832

*Parapiesma* PÉRICART, 1974: 54

Adults. - Preocular tubercles double, subconical, the anterior one is larger than the posterior one (figs. 11 a, b). Pronotum with an usually distinct carina along the median line and an additional lateral carina, sometimes two smaller carinae are developed on each side laterally; the three median carinae start at the anterior margin and usually reach the posterior elevation, sometimes extending to the posterior margin (fig. 1 c). Female: Coiled part of spermatheca relatively long with 5-6 concentric rings and a terminal tube of 2-3 whorles (fig. 12 b).

Subgenus represented by nearly 20 species known to date, distributed in the Palaearctic and Nearctic realms only.

Nymphs (fifth instars). - Preocular tubercles double.

4. *Piesma (Parapiesma) quadratum* (FIEBER, 1844)

? *clavicornis* FABRICIUS, 1775: 694 (*Acanthia*) type ? (Europe); – *quadratus* FIEBER, 1844: 31, pl. II, fig. 7 (*Zosmenus*) neotype (♂, macr., Trieste) M. Vi!; – *dilatatus* JAKOVLEV, 1874: 28 (*Zosmenus*), lectotype (♀ brach., Astrachan) M. Le!; – *convexicollis* JAKOVLEV, 1874 l. c. (*Zosmenus*) holotype (♀ brach., Lower-Volga) M. He!; – var. *rotundicollis* REY, 1888: 189, lectotype (♂, France) M. Ly!; – var. *nigroscutellata* PÉNEAU, 1921: 57, type (France: Isle of Ré) lost; – f. *ruda* JORDAN, 1953: 8, type (Saxonia); – *suaedae* WAGNER, 1954b: 5, holotype (♂, Dalmatia) M. Hg!; – *spergulariae* WOODROFFE, 1966: 107, holotype (♂, Great Britain) B. M.!; – *chiniana* DRAKE ET MAA, 1953: 87, holotype (♀, submacr., Canton, China) USNM!<sup>16</sup>.

REUTER 1888: 218 (synonymies); HORVÁTH 1906: 6; EXT 1923; WILLE 1929; STICHEL 1957: 37; PUTSHKOV 1974: 62; HEISS & PÉRICART 1975: 523 (synonymies, lectotypes), *ibid.*: 535 (neotype).

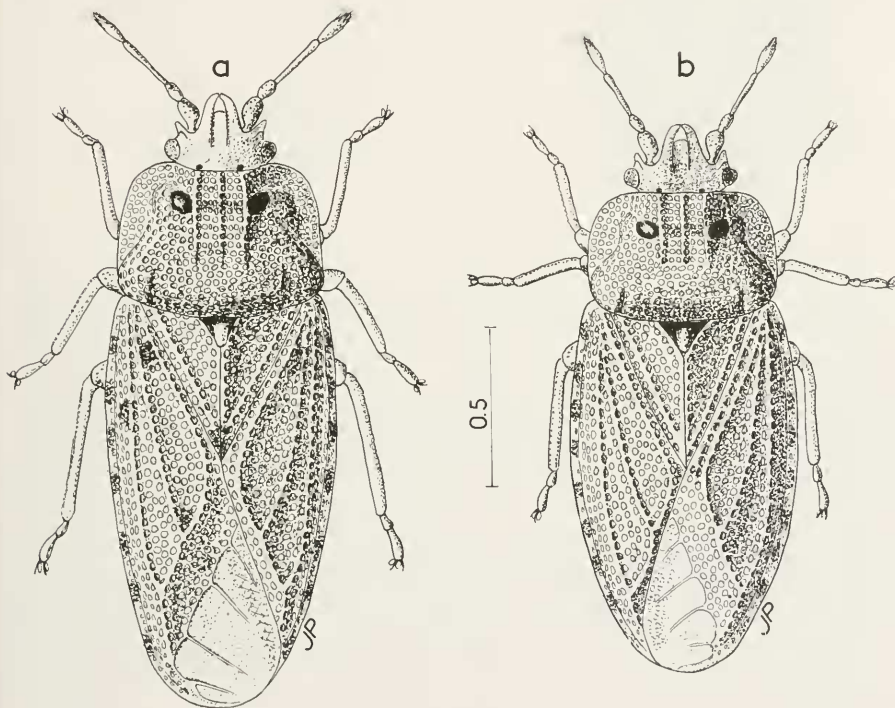


Fig. 19: *Piesma quadratum*. – a, ♂, macropterous; b, ♂, submacropterous. – Scale in mm. – (Original).

<sup>16</sup> The confusion results from a hardly visible median carina, as sometimes developed in submacr. forms, thus the authors stated “bicarinate”, which led them to the wrong relationship.

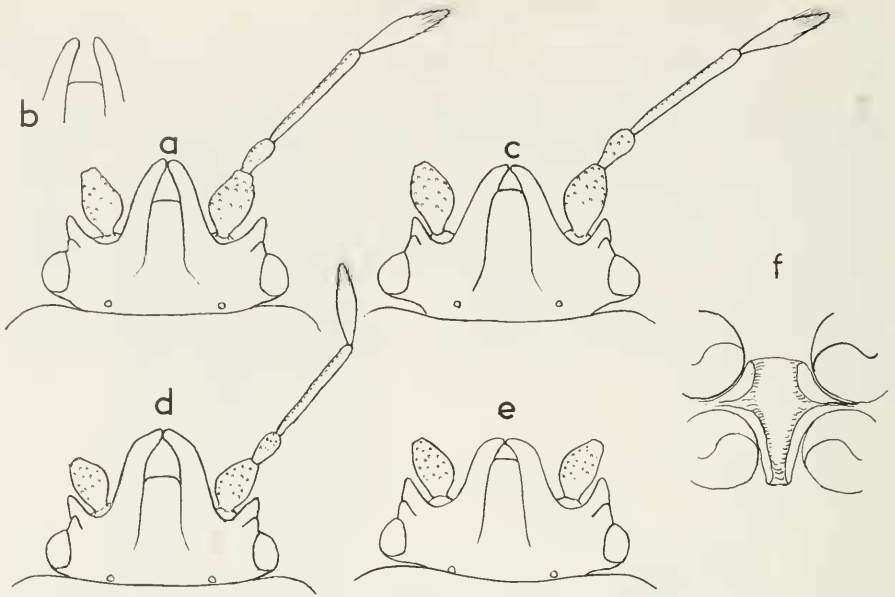


Fig. 20: Head of *Piesma quadratum*. — a, b, d, males; c, e, females; f, metasternum. — (Original).

Adults. — General shape: macr. figs. 19 a, b, 22 a, b; sub-brach. figs. 21 a, b. Macropterous to brachypterous. Color uniformly greenish-yellow, or with a reddish tinge, or fuscous-grey, mottled more or less with brown. Preocular tubercles double; juga long, constricted anteriorly, its apices contiguous; in male surpassing the clypeus about the length of the eye, in female only 0.5–0.7 times (figs. 19 a, b, c, d, e); color of head variable due to the general melanism; antennae pale, third segment 0.45–0.60 times as long as the diatone and 1.3–1.8 times as long as the fourth segment. Rostrum reaching the posterior margin of procoxae. Pronotum 1.3–1.6 times as wide as its maximum length, its three carinae visible on anterior  $\frac{2}{3}$ ; marginal laminae expanded with two rows of sometimes large areolae and frequently an incomplete third row; lateral margins never sinuate at middle but its shape varies from subparallel, slightly converging anteriorly (forma *typica*) or nearly parallel (forma *rotundicollis*) to evenly convex (forma *suaedae*). Hemelytra 1.25–1.70 times as long as their maximum width, reaching (brach., submacr.) or extending distinctly beyond apex of abdomen; membrane variable in length. Male paramere: fig. 4f.

Length: male 2.15–2.90 mm, female 2.40–3.40 mm; antennal segments I:II:III:IV = 0.11–0.14: 0.09–0.12: 0.24–0.36: 0.17–0.23 mm; rostral segments I:II:III:IV = 0.14: 0.12: 0.07: 0.22 mm.

Width: across hemelytra 1.05–1.45 mm.

The number of individuals with uniform pale color seems to increase with brachypterism; the latter, correlated with a reduction in size, is more frequent and more striking in the southern parts of the area of distribution where the majority of populations seem to be concerned (Languedoc, Corsica). In contrast most populations of the northern areas (e. g., shores of the Channel and Baltic Sea) are macropterous or submacropterous.

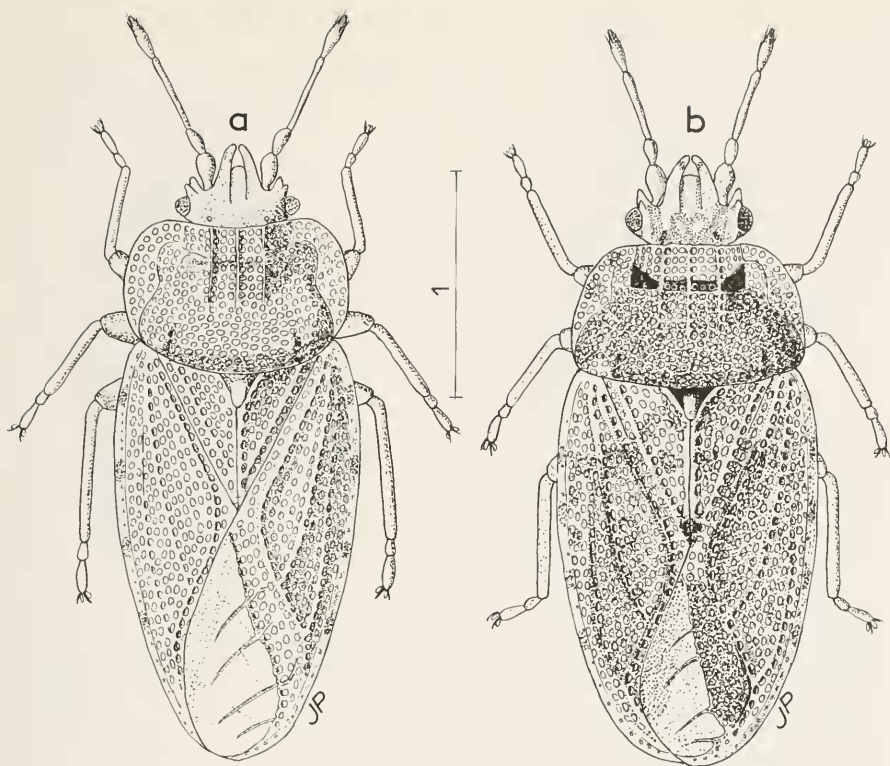


Fig. 21: *Piesma quadratum*. – a, ♀, subbrachypterous; b, ♂, subbrachypterous (Corsica). – Scale in mm. – (Original).

The name *dilatatum* refers to sub-brachypterous forms of uniformly yellowish-green color; this taxon as well as *rotundicollis* (fig. 21 a) and *suaedae* (fig. 22 a) must be considered as synonyms of *quadratum*; the varieties *ruda* and *nigroscutellata* have no taxonomic value at all. *P. convexicollis* (fig. 23 a) refers to the very rare brachypterous form.

*Piesma spergulariae* (fig. 22 b) is represented by small submacropterous to sub-brachypterous specimens showing remarkably shorter antennae (third segment 0.45 times as long as the diatone) and legs; it concerns an isolated population of the British Isles of Scilly with a particular living habit (see later on); this taxon is perhaps a subspecies.

Eggs (figs. 6 a, b, c). – Referring to WILLE (1929) and own observations on French material (Languedoc). Pale yellow when freshly deposited, darkening to yellowish-brown later; two times as long as their diameter. Chorion finely reticulate-shagreenate with five longitudinal carinae which obliterate before the poles. Pseudopericolum with 5–6 micropylar processes arranged in the form of a crown. Length 0.5–0.7 mm; width: 0.25–0.30 mm.

Immature stages. – According to PROESLER (1978 a), the number of nymphal stages varied from four to six in *Piesma quadratum*. From eight specimens, one developed in four

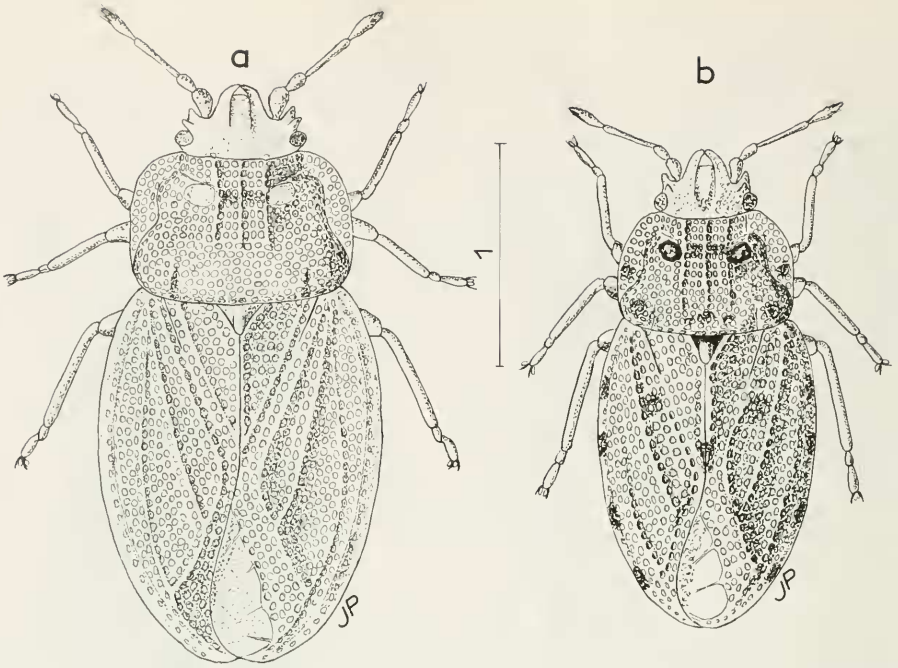


Fig. 22: *Piesma quadratum*. – a, ♂, macropterous (Jugoslavia: Dalmatia, paratype of *suacdae*); b, ♂, submacropterous (Islands of Scilly, paratype of *spergulariae*). – Scale in mm. – (Original).

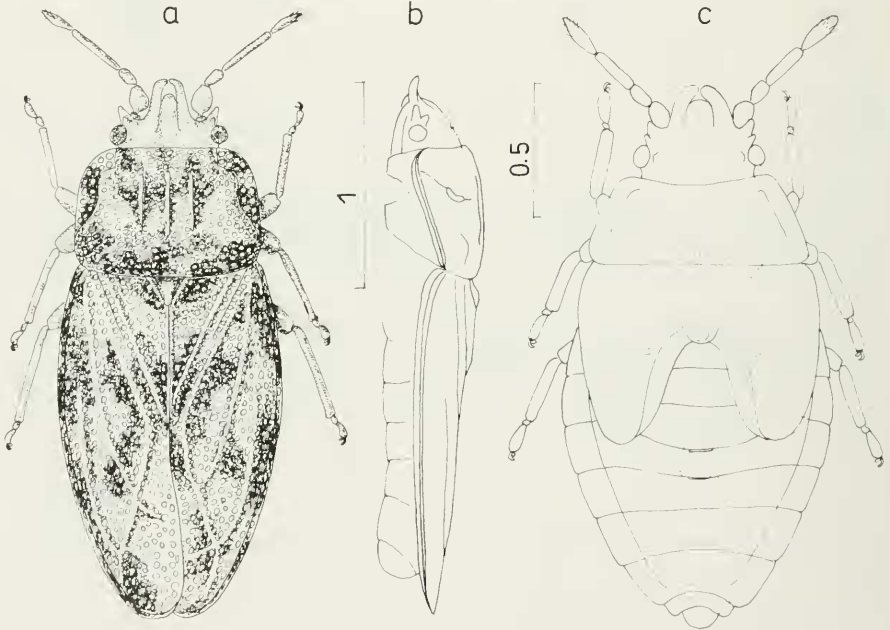


Fig. 23: *Piesma quadratum*. – a, b, ♂, brachypterous (Mongolia); c, nymphal instar V, male sub-brachypterous specimen (France). – Scale in mm. – (Original).



stages, six in five stages and one in six stages. This proportion seemed to be independent of sexes.

Description. – Referring to WILLE (l. c.) and own observations of instars III, IV and V from Languedoc (France). The instars I–IV are very similar to those of the closely related species (see *P. variabile*).

Fifth instar (figs. 23b, 9a, b). – Juga surpassing the clypeus by a length equal to their diameter in males and less in females, constricted anteriorly and contiguous at apex (male). Antennae 0.7 times as long as the basal width of pronotum; relative length of segments I:II:III:IV = 5: 4: 8: 8. Rostrum reaching slightly beyond anterior margin of mesocoxae. Width of pronotum 2.7 times as its median length, subtrapezoidal; marginal laminae discernible. Hemelytral lobes extending beyond anterior margin of tergite IV. Lateral margins of urits not projecting, except on VII and VIII. Length: 1.95–2.8 mm; width: diatone (average) 0.5 mm, abdomen (average) 1.1 mm.

Ecology. – *Piesma quadratum* is in its “wild” state a halophilous species and lives particularly in zones with marine influence or saline soils; it occurs in connection with several *Chenopodiaceae*: *Chenopodium*, *Atriplex*, *Salicornia*, *Suaeda*, *Salsola*, *Obione*, *Schoberia*. The ssp. *spergulariae* is reported from the Islands of Scilly to live on the *Caryophyllaceae* *Spergularia rupicola* LE JOLIS. This species has also been collected on completely different plants, such as *Aster*, *Calluna*, *Reseda*, where it seems to be able to develop on the condition that it has not commenced its development on *Chenopodiaceae*. Investigators rearing this species have reported that it also feeds on *Spinacia oleracea* L., *Polygonum*, and some *Cruciferae* such as *Raphanus*, *Sinapis*, *Thlaspi* and *Brassica*, as well.<sup>17</sup>

Furthermore, this *Piesma* attacks cultures of sugar beets and fodder beets, namely in Germany, where it is the vector of the virus disease called “Kräuselkrankheit”, meaning beet leafcurl disease, since the beginning of this century. Numerous papers deal with its ecology, as DYCKERHOFF (1924), SCHUBERT (1927), WILLE (1929), KAUFMANN (1935) and LASSACK (1956). The monograph by WILLE is still one of the most complete treatises available on the ecology of a *Piesma* species to date.

When invading the cultures of sugar beets in Germany, *Piesma quadratum* leaves its hibernating quarters in April–May, depending on the climatic conditions, and the insects migrate mostly by flight to the host plants; wind seems to have a predominant influence on this initial spring dispersion.

Mating takes place after migration; it is preceded by a period of stridulation of the males at a cadence of 9 impulses per second which causes agglomerations, and further by a phase of sexual calls with a cadence of 6 impulses per second (LESTON 1957, HASKELL 1958, SOUTHWOOD & LESTON 1959). Oviposition commences a few days later, that means usually in May; it may be extended up to the end of July and sometimes to August. During this period, each female may deposit about 100–160 eggs at a rate of 1–3 per day with intervals of interruption. The eggs are deposited at the stems or leaves of the sugar beets, or even directly on the soil or stones, too; they are glued to the substratum frequently near the nervations of the leaves and parallel to them and deposited sometimes single, sometimes in very small groups.

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17 According to older literature (PUTON 1879), it is also mentioned from *Herniaria glabra*. This indication refers to specimens collected in Landes (France) by PERRIS and it is presumably based on a confusion with *P. variabile*.

Ecdysis begins after 2–3 weeks, and the nymphal development takes 4–6 weeks depending on the climatic conditions (see General, fig. 8a). The most precocious adults are developed in July and after a phase of migration they may start with a second generation; its importance varies and its development sometimes cannot be terminated. Migration to hibernating quarters takes place from August to October; it concerns usually the adult males and the females developed during the summer, as the females of the preceding generation normally do not survive the end of the season and the respective males have long since perished. Hibernation occurs at a maximum depth of 5–15 cm beneath porous soil after the insects moved to the base of the host plants, preferably on dry, sandy and sun-exposed places as slopes, roadsides, bottom of trees, etc.

The adult *P. quadratum* is resistant to starvation; without feeding it may survive for 2–3 weeks at temperatures of 20° C and 4–6 weeks at 10–12° C. During the period of activity, the lack of nourishment causes a progressive lethargy ending in a phase of quiescence with retraction of the appendages; the same effect, which obviously is not different from the condition during hibernation, may be caused by excessive heat or cold; the activities revive after some minutes to some hours when the conditions have again become favorable.

The historical circumstances of the occurrence of *Piesma quadratum* on sugar beets are still badly known. Heavy attacks and the development of the disease were first mentioned at Glogau (Silesia) in 1903, followed by an expansion of the infested area to the north, east and west, reaching Brandenburg and Saxonia (1910), Hannover and Württemberg (1925), Magdeburg (1936), Helmstedt (1945) and crossing the river Weser (1954). This expansion could be stopped but it was not possible to completely free the already infested regions of the disease.

The “Kräuselkrankheit” transmitted by *Piesma quadratum* is a viral infection. Recognized as such in 1929 by WILLE, it was the object of numerous investigations and publications, in particular by VÖLK & KRZAL (1957), PROESELER (1963, 1964a, 1964b, 1964c, 1966a, 1966b, 1966c, 1978a, 1978b, 1978c, 1980), SCHMUTTERER & ERHARDT (1963, 1964, 1965), SCHMUTTERER (1967, 1968, 1980).

This disease is first visible when whitish spots appear on the leaves at the location of the insect’s stings. Later the leaves curl (“Salatkopf”) to a completely faded state as if they were already aged. Young plants are affected by vein clearing, vein deformation and growth inhibition symptoms. In every case, from the economical point of view, the result is an important loss of the sugar beet yield which reaches 75% in the most serious cases.

The fight against this pest has proved difficult due to the natural adaptation of the vector agent to wild *Chenopodiaceae*, its hidden hibernation and the considerable range of its oviposition period. The methods proposed before the Second World War, like the application of baiting strips consisting of several rows of sugar beets, planted in advance at the moment of the seasonal migrations, which after ovipositing started were then plowed under and the soil compressed, allowed moderation of the intensity of the attacks. The use of chemical pesticides such as parathion after 1954 was more successful, but the disease persisted. Other methods of control, such as the dispersion of males of *P. quadratum* that have been sterilized through irradiation and the use of juvenile-hormones blocking the embryonic and nymphal development have been investigated in recent years (WEISS 1976–1977, LEFÈVRE 1976).

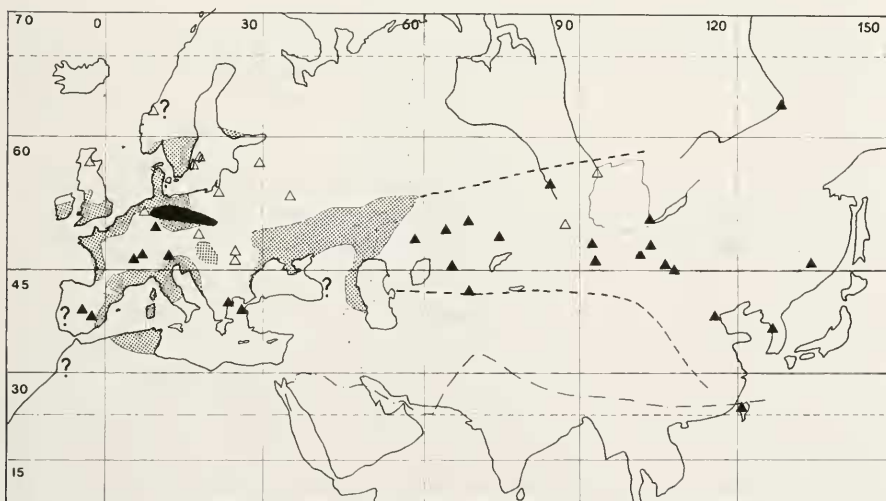
Basically, the cultures on sandy soils are potentially more in danger than those on loamy soils less suitable for hibernation of the *Piesma*.

The disease is transmitted through the saliva. Adults and nymphs of *Piesma* are able to infect plants at an average of 21 to 28 days after acquisition from feeding on diseased plants. This relatively long incubation period in the vector insect is partly assumed to be effected by a barrier created by the intestinal wall. In fact, perforations of the intestinal tract caused by experimental injections considerably reduced the incubation period, as did the injection of virus-infested plant sap into the hemolymph, as well as higher temperatures. Various publications stated that nymphs are not able to transmit the virus. Recent experiments (PROESELER 1978 b, SCHMUTTERER 1980) proved that this misconception was caused by the fact that, under normal conditions, the last moult occurs before the completion of the incubation period.

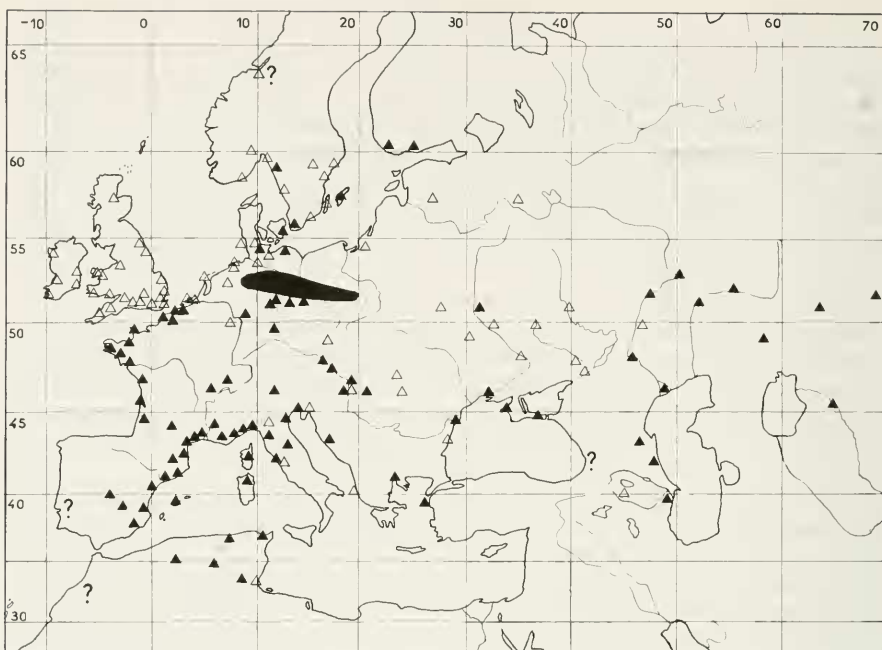
A single acquisition – access feeding is sufficient for the insect to remain infective throughout the time of its life. The virus is, however, not transmitted to the eggs by the females. The investigations made on the conditions of the transmission of this pathogenous agent have revealed the impossibility of a direct contamination of a plant by means of a sap injection from an infected sapling, as well as the obligatory intermediate role played by the *Piesma*. The latter assures not only a prolongation of the virus' survival but almost certainly also its multiplication within the vector's cells.

Besides to sugar- and fodder beets of the *Beta vulgaris*-group, the virus of the beet leafcurl disease can be transmitted to numerous other *Chenopodiaceae*, particularly of the genera *Beta*, *Atriplex*, *Chenopodium*, *Spinacia* and *Tetragonia*. But these plants are of only minor importance for the dispersion of the virus, as its survival and multiplication takes place in the hibernating insects.

It seems, however, that other European species of *Piesma* which occur together with *P. quadratum* cannot transmit the beet leafcurl disease; experiments in this respect with *P. maculatum*, *P. capitatum* and *P. salsolae* (PROESELER 1964 b, 1966 b) have yielded negative results.



Map. 3: Palaearctic distribution of *Piesma quadratum*. The dotted area indicates the regions, where the species shows a more or less continuous distribution; isolated findings are marked with triangles. Entirely black is the area, where *P. quadratum* transmits the virus of the leaf curl disease to the beets.



Map 4: Distribution of *Piesma quadratum* in the Western Palearctic Region. The black area indicates, where this species transmits the virus of the leaf curl disease to the beets.

Only recently has it been discovered in Germany that there exists another disease which can be transmitted to sugar beets by *P. quadratum* (SCHMUTTERER 1976, NIENHAUS & SCHMUTTERER 1976). It has been called "Latente Rosettenkrankheit" or beet latent rosette disease and could be observed only in greenhouses; it infects the young plants which are unable to produce green leaves except those of the first rosette and they die after some weeks. The pathogenous organism, which can be transmitted by adults and nymphs of this *Piesma*, is apparently related to *Rickettsia*. It seems that, under field conditions, the sugar beet can be infected without considerable consequences. The *Piesma* become a vector after 10–30 days of their first contamination and remain so for life as with the beet curl virus.

Distribution (Maps 3, 4). – *Piesma quadratum* is an Euro-Siberian element. Even occurring very abundant by in certain regions, it does not show a continuous distribution. One can find it mainly in littoral areas and far from the sea on saline soils. It occurs certainly in great parts of temperate Asia, from the Caspian Sea to China. The zone where it is noxious to sugar beets is reduced to a narrow belt of east-west extension beginning from Western Poland (Silesia) through GDR and FRG nearly reaching the river Weser (indicated in black on the maps). Such a localization, which obviously reflects that of the virus, is not clearly explained. Sporadic occurrences were also mentioned from Czechoslovakia and the Soviet Union (PROESELER, 1980).

France. Very common in all littoral provinces from Nord to Landes and from the Eastern Pyrenees to the Maritime Alps! Very rare or absent elsewhere: Ain (Lent!, St. Rambert!; G. AUDRAS leg.



> M. Ly), Haute-Garonne (Toulouse: coll. PUTON!). Corsica! – British Islands. Middle and Southern England! Islands of Scilly (types of *spergulariae*)!; Wales, here and there north up to Scotland (Inverness). Ireland: east and west coasts. – Belgium and Netherlands: along northern coastline and near islands. – Switzerland. Peney (M. Gev.!). – Spain. Girona!, Coast of Catalonia!, Island of Mallorca!, Valencia!, Alicante!, Castellón!, Madrid: Aranjuez IV 1975 (L. GIL. leg. > U. Md!), Albacete IX 1974 (SAULEDA leg. > coll. RIBES!). – Portugal? According to STICHEL 1957 (possible, but to be confirmed). – Italy. Not very common. Liguria!, Toscana!, Umbria!, Venezia!, Friuli-Venezia Giulia!, Trentino-Alto Adige! (Bressanone: TAMANINI, 1961), Emilia and Lazio! (SERVADEI, 1967), Sardinia! . Not recorded from the Southern Peninsula nor from Sicily. – Germany (FRG). Hessen: Frankfurt!; Niedersachsen!; Schleswig-Holstein!; Bavaria: Fränkischer Jura!. – Germany (GDR). Littoral of Mecklenburg!, Brandenburg, common!, Thuringia!, Saxony and Anhalt!. – Denmark, common!, (JENSEN-HAARUP, 1912). – Austria. Vienna region!, Burgenland!. – Czechoslovakia. Bohemia, Moravia, Slovakia (HOBERLANDT, 1977). – Poland. Silesia; provinces of Lodz, Poznan and Krakow, Bydgoszcz (SMRECZYNSKI, 1954). – Hungary!. – Romania: Transylvania!, Dobroudja!. – Yugoslavia. Istrian Pen.!, Dalmatia! (types of *suaedae*). – Bulgaria. Varna (JOSIFOV, 1964). – Greece. Saloniki!, Kerkyra!, Korfu (GYLLENSVÄRD, 1967). – European USSR. Kaliningrad (PUTSHKOV, 1974); region of Pskov (id.), Kaluga (id.). Southern Russia; north up to Zhitomir, Kiev!, Voronezh, Saratov!, Kuybyshev! and Orenburg!, south extending to the littoral of the Ukraine (common) and Krym Pen.!. Astrakhan!, Northern Caucasus: Kizliar!, Derbent!. – Transcaucasia. Azerbaidzhan! (Talysh Mts.), Armenia (PUTSHKOV, l. c.). – Norway. Southern region from Risør to Oslo according to WARLOE (1924) and OSSIANNILSSON (1962); indicated also from Trondheim (?). – Sweden. Littoral provinces up to 60° North: Scania!, Blekinge, Halland, Bohuslän!, Östergötland, Närke, Södermanland, Islands of Gotland and Öland (COULIANOS & OSSIANNILSSON, 1976). – Finland. Rare. Region of Turku!, Southern coast!. – Algeria. Chellala!, “Philippeville” (= Skikda!), Biskra!. – Tunisia. Tunis!, Kairuan!, Gafsa, Kébili (Chott el Djérid!). – Turkey. Çanakkale: Gökçeada, V 1975 (EGU!).

Extension in Asia: Probably the main part of Kazakhstan!, Eastern Uzbekistan!, Kirghizia. Southern Siberia from Novosibirsk! to Irkutsk!. Also in Yakutia (VINOKUROV 1979). Mongolia (HOBERLANDT, 1968), there the brachypterous form occurs together with the macropterous form: Gobi Altaj (leg. KIRITSHENKO, M. Le!), Eastern aimak!, Bulgansky aimak!, Ara-Khangaiskij aimak! (all leg. KERZHNER, M. Le), Ostgobi aimak (leg. KASZAB VI 1963, M. Bu!); China (Manchuria: coll. SEIDENSTÜCKER!), Tianjin! (HSIAO et JING 1979); Taiwan! (holotype of *chinianum* DRAKE & MAA 1953); North Korea!

## 5. *Piesma (Parapiesma) salsolae* (BECKER, 1867)

*salsolae* BECKER, 1867: 113 (*Zosmenus*) lectotype (♀, Southern Russia) M. Le!; – *kolenatii* sensu JAKOVLEV, 1874b: 30 (*Zosmenus*) (part.) (nec FIEBER, 1861); – *variabile* sensu HSIAO et JING, 1979: 457, HSIAO et al 1981: 219, photo 278 (nec FIEBER, 1844).

HORVÁTH 1906: 7; STICHEL 1957: 39; HEISS 1972: 64; PUTSHKOV 1974: 67; HEISS & PÉRICART 1975: 527 (lectotype).

Adults. – General shape: fig. 25. Only macropterous forms known. Color very variable: body surface rather shiny, whitish-grey, greyish-green to brownish, sometimes nearly unicolorous, but mostly with brownish spots on the hemelytra, particularly on the hypocostal laminae. Pronotum mostly darker on the posterior half, the anterior margin always whitish. Abdomen greenish or frequently reddish. Preocular tubercles double. Juga parallel, digitiform in males, surpassing the clypeus by 0.8–1.2 times the length of the eye (figs. 24 a, c), those of females shorter,  $\frac{1}{2}$  to  $\frac{1}{3}$  of the length of the eye (figs. 24 b, d); antennae pale, sometimes partly brownish; third segment 0.5–0.6 times as long as the diatone and 1.5–1.6 times as long as the fourth segment. Rostrum reaching slightly be-



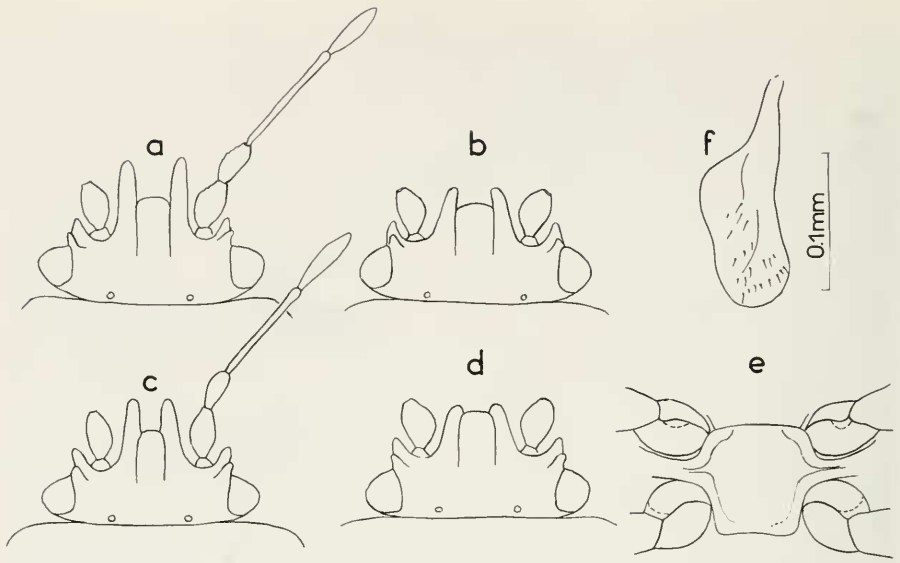


Fig. 24: *Piesma salsolae*. – a, c, males; b, d, females; e, metasternum; f, paramere. – (Original).

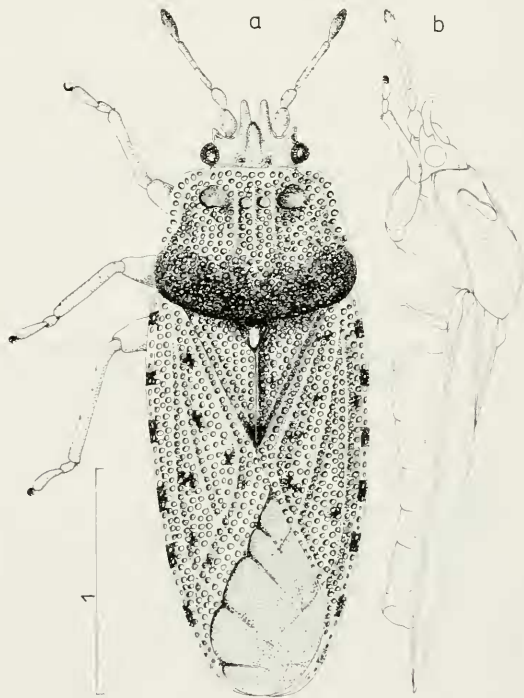


Fig. 25: *Piesma salsolae*. – a, ♂, macropterous (Italy), dorsal view; b, id., lateral view. – Scale in mm. – (after HEISS, 1972).

yond procoxae. Pronotum 1.3–1.45 times as wide as its median length; in profile subrectangular on anterior  $\frac{2}{3}$  (fig. 25 b); the three carinae almost visible on the anterior  $\frac{2}{3}$  of the disc; marginal laminae very narrow with one row of areolae and sometimes some additional ones anteriorly; lateral margin sinuate at middle. Hemelytra 1.5–1.65 times as long as their maximum width, relatively narrow and on an average more regularly attenuated than in *P. variable*; membrane extending beyond apex of abdomen by  $\frac{1}{2}$  of its length. Metasternum hexagonal, remarkably wide (fig. 24 e). Male paramere: fig. 24 f.

Length: Male 2.65–2.95 mm, female 2.85–3.25 mm; antennal segments I:II:III:IV = 0.12–0.14 : 0.10–0.12 : 0.27–0.36 : 0.18–0.22 mm; rostral segments I:II:III:IV = 0.14:0.12:0.07:0.22 mm.

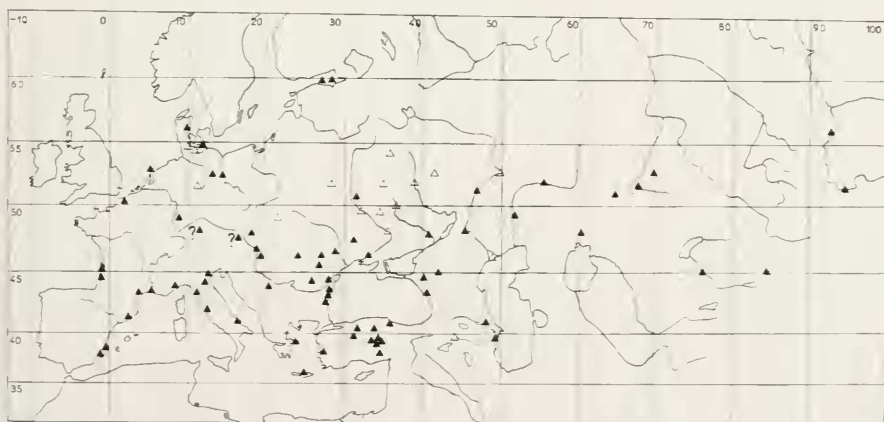
Width: across hemelytra 1.05–1.40 mm.

This species can easily be distinguished from *P. quadratum* by the narrow and sinuate pronotal margin and from *P. variable* by the wider metasternum, more slender antennae and usually larger size.

Eggs (figs. 10 a, b). – Referring to PUTSHKOV, 1974. Yellow, robust, slightly curved, twice as long as their diameter. Pseudopericulum with 5 micropylar processes. Length 0.63 mm; width 0.30 mm.

Immature stages. Fifth instar. – According to own observations on specimens from Italy (Rome). Very similar to those of *P. variable*; third antennal segment somewhat more elongate, longer than the fourth segment; relative length of segments I:II:III:IV = 6.5:5.5:13:11. Length: 2.0–2.7 mm; width: diatone 0.6 mm, abdomen: male 1.0 mm, female 1.2 mm.

Ecology. – This species inhabits the littoral dunes and saline soils of marine shores and banks of certain rivers, where it usually develops on *Chenopodiaceae* of the genus *Salsola*. In Western Europe it is always recorded from *Salsola kali* L. since HORVÁTH, (1906) and other observations as of GRAVESTEIN (1959) in the Netherlands and HEISS (1972) in Italy near Rome. According to PUTSHKOV, its connection with *Salsola* is to be confirmed in Russia; he found it in the lower valley of Dniepr on *Corispermum* sp., but never on *Salsola pestifera* A. NELS. or *S. ruthenica* ILJIN, also growing there.



Map 5: Distribution of *Piesma salsolae* in the Western and Middle Palaearctic Region.

Adults have been collected from June to September. PUTSHKOV has observed considerable oviposition at the end of June and nymphal eclosion in July in the region of Zaporozhie. Near Rome in Southern Italy one of the authors (EH) has noted the coexistence of adults and nymphs of all instars between 20th of July and 15th of September. This fact leads to the assumption of a considerable extension of the oviposition period and the overlapping of two generations.

Distribution (Map 5). – *Piesma salsolae* shows an Euro–Siberian distribution. It is widely spread in Central Europe but sometimes rare and locally restricted.

France. Only along the seaside and nowadays probably very rare due to the ecological degradation of shores; in older collections confused with *P. variabile*, notably by PUTON. No recent captures. Nord: Dunkerque (coll. NOUALHIER > M. Pa!); Vendée: Island of Noirmoutier (PÉNEAU, 1914); Gironde: Cap Ferret (J. BRAQUEHAYE leg. > M. Bc!); Landes: Arcachon (in coll. PUTON > M. Pa. under the name „*variabile*“); Hérault: Palavas (LAVAGNE leg. in coll. A. PERRIER > M. Pa!); delta of Rhone: Etang de Vaccarès, 9 V 1920 (CHOBOUT leg. > coll. MORÈRE!). – Netherlands. Island of Texel, 29 VII 1947 (GRAVESTEIN leg. > M. Am!; GRAVESTEIN 1959). – Spain. Catalonia: Llobregat IX–X 1968 (div. coll.!); Castelldefels VII 1950, IX 1962 (id.!).; Valencia (div. coll.!); MORÓDER SALA 1920, etc.); Alicante: Torrevieja, XII 1893 (ESCALERA leg. > IEM!). – Italy. In the literature confused with *P. variabile*. Liguria: Allassio, IV–V 1943 (SOLARI leg. > M. Ge!); Toscana: Viareggio (DODERO leg. > M. Ge!); Veneto: Bologna, IV 1889 (M. Bo!); Venice (coll. FOKKER > M. Ld!); Lazio: littoral near Rome! (HEISS 1972); Puglia: Mt. Gargano, 9 IX 1972 (TAMANINI leg. et coll.). – Germany (FRG). Hessen: Mainzer Sand, IX 78 (HEISS leg. et coll.); Baden–Württemberg: Sandhausen, 8 XI 1977 (VOIGT leg.!, BURGHARDT & RIEGER 1978); Bavaria: Munich, 5 VIII 1961 (REMANE leg. et coll.!); Schleswig–Holstein (WAGNER & WEBER 1967), Island of Fehmarn 13 IX 1949 (ECKERLEIN leg. > M. Gev.!). – Germany (GDR). Anhalt: Ascherleben (PROESLER 1966 a); Brandenburg: env. of Berlin, Wilhelmshagen, IX 1937 (M. Be!); MICHALK 1938), Frankfurt/Oder (SCHUKATSCHEK leg. in coll. WAGNER > M. Hg!), Saxony: Leipzig, XI 1967 (K. DORN leg. > M. Be!), Döbeln, VIII 1949 (id.!). – Danmark: Jutland: Mols (M. He!) Renders! New record for Denmark. – Austria. Lower Austria (HANDLIRSCH leg. > M. Vi!). – Czechoslovakia, Slovakia mer.: Cenkov, 10 VI 1962, 30 V 1963, etc (ŠTYS leg. et coll.!); Slovakia or.: „Beretö“ (HORVÁTH 1897). – Hungary. Very common (HORVÁTH 1897); Budapest and env. (M. Bu!), Kécskemét (id.!). – Romania. Dobroudja: Macin (M. Bc!), Constanta (id.!).; Valachia: Bucarest (M. Bc!), Plainesti (M. Bc!); Moldavia: Valley of Barlad (id.!).; Transylvania!: Dumbraveni (O. SCHNEIDER, 1976); Banat (HORVÁTH 1897). – Yugoslavia. Vojvodina (HORVÁTH 1897); Serbia: Zatonje, north of Gradiste, 27 VIII 1954 (STANČIĆ leg. in coll. WAGNER > M. Hg!). – Bulgaria. Littoral regions: Varna!, Nessebar!. Probably not rare. – Greece. Athens (EMGE leg. > M. Am!), Piraeus 10 VIII 1958 (LINNAVUORI leg.!), Acarnania (HORVÁTH 1906). Isle of Crete: Iraklion, 28 X 1972 (ELLIS leg. > M. Am!), id. (HEISS leg. 1980!). – European USSR. Karelia: Isle of Lavansaari in the Finnish Gulf (KREGELIUS leg. > M. He!); Island of Tytärsaari and Seiskari (HELLEN leg. > M. He!); Bielorrussia: Prypiat valley (PUTSHKOV 1974); Moldavia: Kishinev!; according to PUTSHKOV l. c. East and South of Ukraine; RFSSR: north to Kaluga, Voronezh, Saratov!, Kuybyshev, Orenburg!; Northern Caucasus: Stavropol!, Krasnodar!, Abkhazkaya ASSR!, Daghestan (Kizliar!), Astrachan (JAKOVLEV 1874 a). – Transcaucasia. Azerbaidzhan: Talysh Mts!; Armenia: Valley of Araxes (HORVÁTH 1906). – Turkey. Hasanoğlan, 13 VII 1947 (HOBERLANDT 1955, cited as *silenis*!); Izmir: Bornova 20 IV 1977 (EGU!); Kayseri: Yeşilhisar 13 III 1979 (EGU!); Ankara: Koroğlu, 20 VIII 1979 (EGU!); Eskişehir: Sivrihisar 5 V 1979 (EGU!); Nevşehir: Gülşehir 16 VIII 1979 (EGU!); Çankiri 3 VIII 1979 (EGU!); Kirşehir: Mucur 18 VIII 1979 (EGU!); Niğde: Ulukışla 16–22 V 1965 (SEIDENSTÜCKER leg. et coll.!); Çiftelhan 27–31 V 1955 (id.!).; Samsun, numerous, 4–6 IX 1966 (SEIDENSTÜCKER leg.!). –

Extension of Asia. Kazakhstan: North and Northwest, probably with further distribution: Antinovka, VII 1925 (LUKIANOVICH leg. > M. Le!); Borovoye VIII 1937 (ZIMIN leg. > M. Le!); Atbasar (M. Le!); Lake Ak–Suat 250 km south of Kustanaya, VII 1935 (FORMOSA leg. > M. Le!); Chelkar 100 km north of Lake Aral (M. Le!); Southeast: region of Lake Balkash, Bakanas (M. Le!); Dzhun-

garsky Alatau, VII 1960 (KERZHNER leg. > M. Le!). Siberia: Omsk!; Krasnoyarsk!; Lena-valley between Kirensk and Vitim!; Transbaikalia. Tuvinskaya ASSR and Mongolia (PUTSHKOV l. c.); Central aimak!, Südgobi aimak!, Chentej aimak!, Mittelgobi aimak!, Dundgobi aimak (all leg. KASZAB VI–VII 1965–1968, M. Bu), Central aimak!, Gobi Altaj aimak!, Ara-Khaganskij aimak!, Ubrunskij aimak!, Dzabchanskij aimak!, Sukhe Bator aimak! (leg. KERZHNER, EMELJANOV, KOZLOV VI–VIII 67–71, M. Le); China: Peking, Tianjin! (HSIAO et JING 1979 as *variabile*).

## 6. *Piesma (Parapiesma) variabile* (FIEBER, 1844)

*variabile* FIEBER, 1844: 32, pl. II fig. 8, 10, 12–16 (*Zosmenus*) lectotype (♂, Bohemia) M. Pa!; – ? *maculatus* sensu JAKOVLEV, 1874 b: 24 (nec LAPORTE DE CASTELNAU) (*Zosmenus*), – *variabile* var. *brevicornis* REY, 1888: 189, lectotype (♀ macr., France) M. Ly!.

PUTON 1879 b: 85; STICHEL 1957: 39; HEISS 1972: 66; PUTSHKOV 1974: 68; HEISS & PÉRICART 1975: 527 (lectotypes).

Adults. – General shape: macr. fig. 27 a, submacr. figs. 27 b, c. Macropterous to submacropterous. Body surface usually rather shiny, its color very variable from yellowish to brownish, greenish; sometimes nearly unicolorous, sometimes with brownish spots on hemelytra; abdomen greenish, brown or reddish. Preocular tubercles double. Juga parallel, digitiform, sometimes darkened apically, surpassing the clypeus by 1.1–1.3 times the length of the eye in males (fig. 26 a); those of females only of  $\frac{1}{2}$  this length and usually recurving anteriorly (fig. 26 b); antennae pale except the fourth segment, which is sometimes apically or fully darkened; third segment 0.35–0.45 times as long as the diatone and 1.15–1.30 times as long as the fourth segment. Rostrum reaching beyond the procoxae to the middle of the mesosternum. Pronotum 1.35–1.50 times as wide as its medial length,

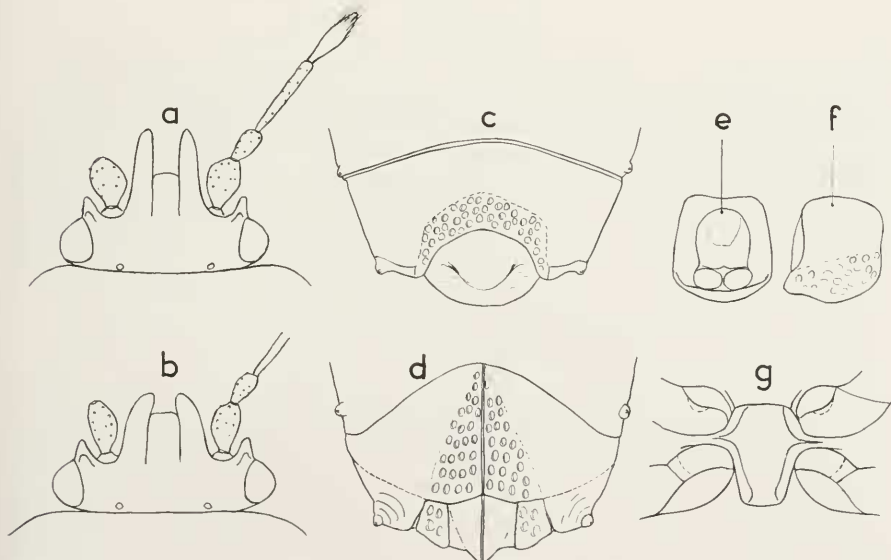


Fig. 26: *Piesma variabile*. – a, ♂, head, dorsal view; b, id., ♀; c, male terminal segments, ventral view; d, female terminal segments, ventral view; e, f, pygophore; g, metasternum. – (Original).

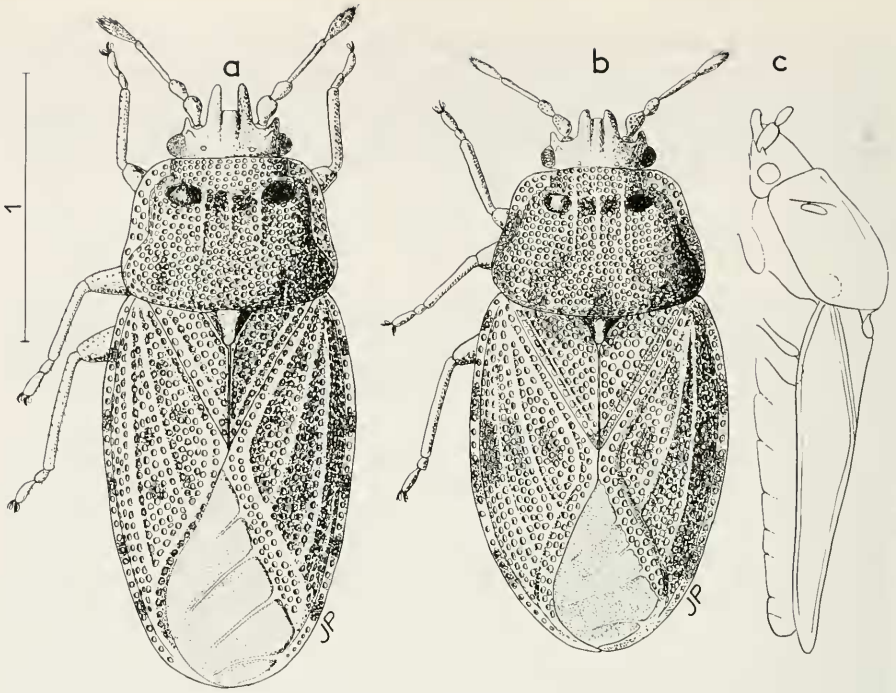


Fig. 27: *Pisma variable*. – a, ♂, dorsal view; b, ♀, dorsal view; c, id., lateral view. – Scale in mm. – (Original).

the median carina short and feebly developed, the two lateral ones longer and fairly visible; marginal laminae very narrow with one row of areolae, sometimes at middle and anteriorly some additional areolae present; lateral margins slightly sinuate at middle, converging anteriorly. Hemelytra 1.3–1.6 times as long as their maximum width in males and 1.2–1.4 times in females; membrane extending beyond apex of abdomen by  $\frac{1}{2}$  of its length in macropterous forms and only slightly surpassing it in submacropterous forms. Metasternum distinctly longer than wide, especially in males (fig. 26 g). Genital segments of male fig. 26 c, pygophore figs. 26 e, f, parameres fig. 29 e. Female genital segments fig. 26 d.

Length: 2.25–2.90 mm; antennal segments I:II:III:IV = 0.11–0.13:0.09–0.11:0.19–0.26:0.16–0.21 mm; rostral segments I:II:III:IV = 0.14:0.11:0.08:0.22 mm.

Width: across hemelytra 1.0–1.40 mm.

Eggs (figs. 10 j, k). – Greyish-green when freshly deposited, later darkening to brownish, about two times as long as their maximum diameter. Chorion not curved with about ten longitudinal carinae which obliterate before the poles. Pseudopericulum with five micropylar processes forming a crown. Length: approximately 0.50 mm; width: 0.25 mm.

Immature stages. – Own observations made on eggs and nymphal instars collected in the Paris Basin (Fontainebleau).

Nymphs. – Ovale, depressed, pale green with reddish eyes; antennae and legs whitish except the fourth antennal segment and the last tarsal segment, which are darkened apical-



ly; rostrum also brownish at apex. A red spot occurs at the place of the dorso-abdominal scent glands.

First instar (fig. 7a). Eyes composed by about ten ommatidia. Rostrum reaching the posterior margin of metacoxae. Tarsi without claws, but parempodia already developed. Length: 0.6–0.7 mm.

Second instar (fig. 7b). Eyes composed by numerous ommatidia. Jugal reaching apex of clypeus. Antennae slightly longer than the width of frons between the eyes, relative length of its segments I:II:III:IV = 5:5:5:8. Rostrum reaching beyond mesocoxae, relative length of its segments I:II:III:IV = 7:5:3,5:10. Claws developed. Length: 0.75–0.80 mm; width: diatone 0.20 mm, abdomen 0.25–0.30 mm.

Third instar (fig. 7c). Jugal reaching apex of clypeus. Relative length of rostral segments as second instar. Hemelytral lobes discernible as slight sinuosities of posterior margin of mesonotum. Posterior margin of metanotum straight. Length: 0.8–1.0 mm; width: diatone 0.34 mm, abdomen 0.50 mm.

Fourth instar (fig. 7d). Jugal reaching slightly beyond apex of clypeus. Antennae a little longer than the diatone, relative length of segments I:II:III:IV = 6:5:8:10. Rostrum reaching middle of mesocoxae, relative length of its segments I:II:III:IV = 10:6.5:5.5:13.5. Hemelytral and alar lobes developed, the latter only partly concealed by the first, reaching middle of tergite II. Length: 1.4–1.8 mm; width: diatone 0.42 mm, abdomen 0.7–0.8 mm.

Fifth instar (fig. 7e). Jugal straight, surpassing the clypeus by  $\frac{1}{2}$  of the length of the eye in males, much smaller in females. Antennae 0.7 times as long as the basal width of pronotum, relative length of segments I:II:III:IV = 6.5:6:9:11. Rostrum reaching anterior margin of mesocoxae. Pronotum subtrapezoidal, two times as wide as its length; marginal laminae narrow, but discernible. Hemelytral and alar lobes distinctly developed, the first reaching beyond the anterior border of tergite IV and concealing the latter except on the inner margin. Length: 1.8–2.5 mm; width: diatone 0.55–0.60 mm, abdomen 1.0 mm (male) or 1.2 mm (female).

Ecology. – *Piesma variabile* occurs on rather dry, sunny and sandy soils where its host plant grows. According to several concordant observations in Bohemia (FIEBER 1844), Austria (FUNK 1890), France (region of Bordeaux, leg. G. TEMPÈRE!, Fontainebleau, leg. PÉRICART!), Russia (Belgorod, sec. KORINEK, 1939) the host plants are small *Caryophyllaceae* of the genus *Herniaria*, namely *Herniaria glabra* L. It has also been found on *Sagina procumbens* L. (DUDA, 1885) in Bohemia and on *Drypis spinosa* L. (HORVÁTH, 1906) in Hungary. Further host plants are mentioned in earlier literature: *Tuberaria guttata* (L.) FOURR. (= *Helianthemum guttatum* MILL.) in France (PUTON, 1879), *Lytbrum portula* (L.) D. A. WEBB (= *Peplis portula* L.) in Bohemia (DUDA l.c.), also *Chenopodium* sp. and *Salsola kali* L. Most probably, these references are incorrect, basing on superficial observations, as the small plants of *Herniaria* spread on the soil do not attract the attention, so that confusion with more noticeable plants in the same locality is possible.

*Piesma variabile* hibernates beneath litter and detritus, frequently near the place of its development. Mating and oviposition start in early May and continue without interruption during the whole warm season; the first adults of the new generation appear since the middle of June. At this period, one of the authors (JP) has observed in 1973 rich populations consisting of adults and nymphs of all instars with a great number of mating specimens, including certain still teneral adults, belonging obviously to the summer generation. This was on sandy clearings of an ancient shooting ground in the Fontainebleau Fo-

rest. The insects perforated the leaves and sepals of *Herniaria glabra* with their nutritional stings. The numerous eggs have been glued isolated or paired usually to the external margin of the sepals or on the upper surface of the leaves (fig. 28). According to PUTSHKOV, the observed life cycle is nearly identical in the Ukraine; there the second generation has already been developed by June–July and a third one appeared eventually in July–August, thus considerably overlapping each other.

These small *Heteroptera* show little mobility, and as the nymphs have the same light green color as *Herniaria*, they can be discovered only by careful examination of the plants or the sandy soil beneath their creeping branches.

Distribution (Map 6). – *Piesma variable* is an Euro-Siberian (?) element. Its distribution is incompletely known due to the fact of its hidden way of life and the easy confusion with the closely related species *salsolae*, *silenes* and *pupula*. It seems to be present in a great part of Central Europe.

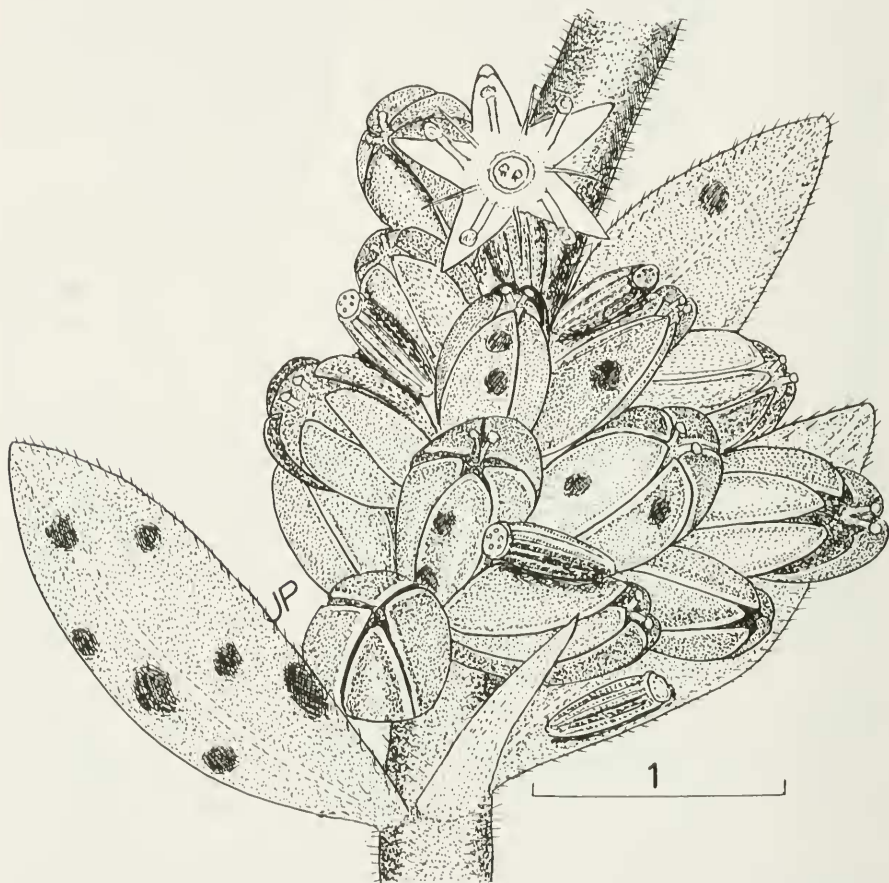


Fig. 28: Eggs of *Piesma variable* deposited on buds of its host plant *Herniaria glabra* (France: Fontainebleau, VI 1973, PÉRICART). – Scale in mm. – (Original).



Map 6: Distribution of *Pisma variable* in the Western Palaearctic Region.

France. Envir. of Paris: Paris (ancient collections!), Forêt de Fontainebleau (PÉRICART, VI 1973, 1974!); Maine-et-Loire: St Rémy la Varenne, 1899 (DU BUYSSON leg in coll. NOUALHIER > M. Pa!); Loire-Atlantique: Isle of Noirmoutier (PÉNEAU, 1914); Allier: Brout-Vernet (DU BUYSSON leg > M. Bc!); Lot-et-Garonne: Casteljalous VIII 1982 (A. MATOCQ leg.); Rhône: Lyon (coll. REY > M. Ly!); REY, 1888); Ain: "Bresse" (id.) (lectotype of *brevicornis*); Gironde: Le Gurg, VI 1971 (TEMPERE leg > coll. PÉRICART!); Gradignan near Bordeaux VIII 1976 (id.); "Landes" (GOBERT leg. in coll. ROYER > M. Pa!); Alpes-Maritimes: Cannes (coll. SIGNORET > M. Vi!). – Switzerland: Peney (SIMONET leg. > M. Gev.). – ? Spain. Valencia (MORÓDER leg. sec. GOMEZ-MENOP 1955). – ? Portugal. Rio de Mouro, 27 VII (LINDBERG 1962). – Italy. "Italia tota" (GARIBGIETTI, 1869); Isle of Giglio (MANCINI 1952), Liguria (MANCINI, l.c.), Emilia (SERVADEI, 1967), Toscana (MANCINI, 1963). The record from Veneto, mentioned by BLÖTE (1945) and the following authors refers to *P. salsolae*! In spite of all these citations, we have yet not seen any specimen from Italy. – Germany (FRG.). Bavaria: env. of Nuremberg (sec. KITTEL) and of Bamberg (sec. FUNE) following HUEBER 1893; Lower Saxony: Hannover, Neu Darchau VII 1935 (M. Am!), Lubeck (SCHUMACHER 1918); Schleswig-Holstein! (WAGNER & WEBER 1967). – Germany (GDR). Thuringia: Arnstadt, Erfurt, Atern (RAPP 1944); Saxony: Karl Marx Stadt (JORDAN 1963), Schandau (SCHUMACHER 1919); Anhalt: Halle (SCHUMACHER 1913); Brandenburg: Berlin (M. Be!, old specimens); Mecklenburg: dunes near Warnemünde, VI–VIII (WENDT leg. > M. Be!). – ? Denmark (JENSEN-HAARUP, 1912; not refound since 70 years (MÖLLER ANDERSEN & GAUN 1974), (= submacr. *quadratum*!). – Austria. Vienna (FIEBER 1844); Burgenland: Illmitz (div. coll.); North Tyrol: Reutte, VII 1916 (HEISS 1973); Carinthia: Möderndorf, V (PROHASKA 1923). – Czechoslovakia. Bohemia! (lectotype of *variabile*), Sobieslau VIII–IX (DUDA), Prague (FIEBER 1844); Moravia: Čejč u. Hod. V 1941, Rohatec VII 1942, (HOFFER leg., HOBERLANDT 1943), Uherčice, VII 1941 (HOBERLANDT, 1942). – Poland. Pomerania: Bellinchen a. Oder, III 1937 (M. Be!); ? Silesia (H. SCHOLZ 1847). – Yugoslavia. Croatia: "Carlopage" (= Karlobag) (M. Bu!). – Greece. Attica (EMGE leg., sec. REUTER 1891); Macedonia: pass of Pisoderion, alt. 1600 m., 2 VII 1975 (DUFFELS leg. > M. Am!). – European USSR. Kaliningrad (STICHEL 1960); Tatarskiy ASSR (PUTSHEV 1974); Bielorrussia: Polozk IV–VII 1942 (SEIDEN-

STÜCKER leg.), Bobruysk, Mozir (PUTSHKOV, l.c.); Ukraine: Kiev!, Poltava, Kharkov, Lougansk, Zaporozhie, Kherson, Odessa, Krym! (PUTSHKOV l.c.); RFSSR prov. of Kursk (KIRITSHENKO 1951), Belgorod (M. Le!), Rostov n. D. (M. He!), Lower-Volga, Orenburg, North Caucasus (PUTSHKOV l.c.). – Transcaucasia. (PUTSHKOV l.c.).

Extension in Asia. Kazakhstan (PUTSHKOV l.c.); Siberia: Irkutsk (HORVÁTH 1906); Yakutsk (VINIKUROV 1979). – The records from Mongolia: South Gobi aimak 26 VII 66 (HOBERLANDT 1974!) and China: Peking, Tianjin (NUT!), reported by HSIAO et JING 1979, HSIAO et al 1981, refer to *P. salsolae*.

Note 1. The record from Hungary, mentioned by HORVÁTH, 1906, concerns a locality now in Croatia as mentioned above; the one from Bulgaria by JOSIFOV, 1964, refers to *P. salsolae*!

Note 2. The reference from Algeria by HORVÁTH, 1906, could not be confirmed, thus the occurrence of *P. variabile* in North Africa is still to be verified.

### 7. *Piesma (Parapiesma) silenes* (HORVÁTH, 1888)

*silenes* HORVÁTH, 1888: 176 (*Zosmenus*) lectotype (♂, Hungary) M. Bu!; – *tesquorum* KIRITSHENKO 1954: 301 (nomen nudum)!

HORVÁTH 1906: 7; ŠTYS 1963: 305; STICHEL 1957: 40; HEISS 1971: 17; HEISS 1972: 63.

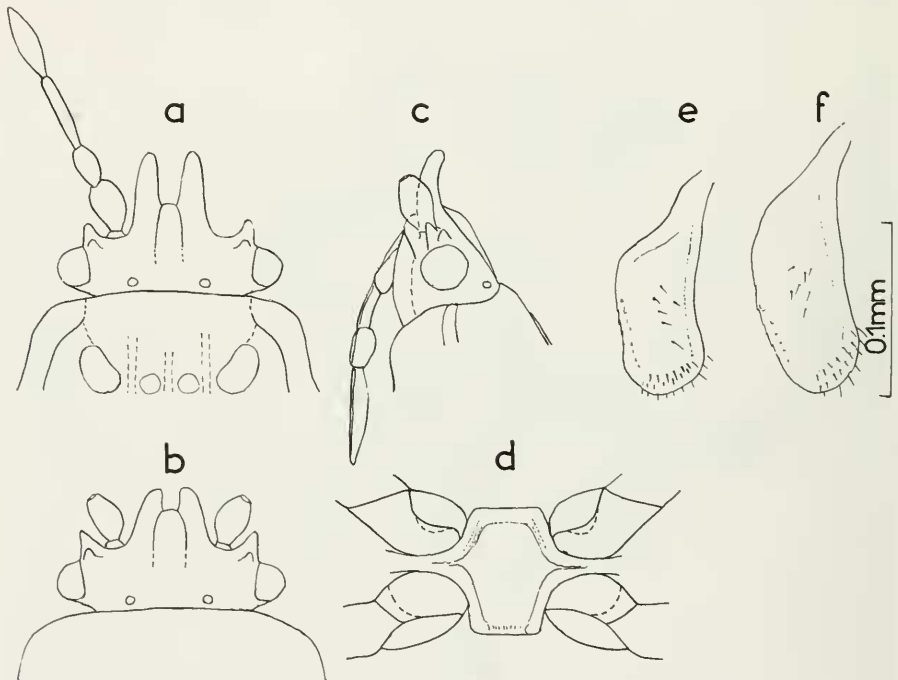


Fig. 29: a–d, *Piesma silenes*. – a, c, ♂, head, dorsal and lateral view; b, ♀, head, dorsal view; d, metasternum; e, *P. variabile*, paramere; f, *P. silenes*, paramere. – (a–c after HEISS, 1971; d–f, Originals).

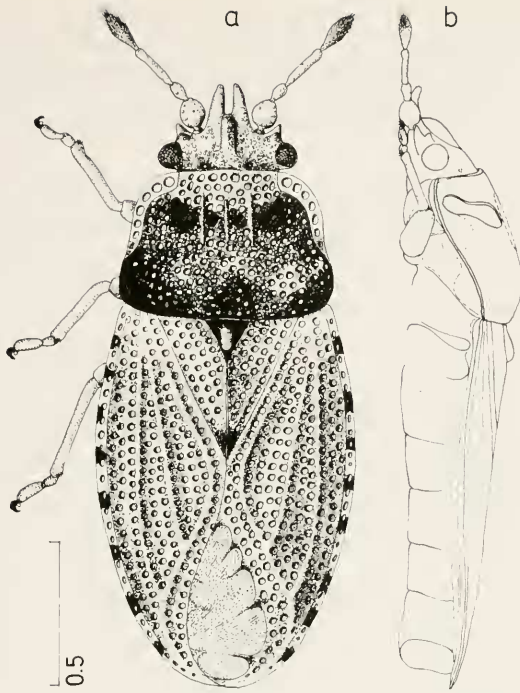


Fig. 30: *Piesma silenes*. – a, ♂, submacropterous, dorsal view; b, id., lateral view. – Scale in mm. – (after HEISS, 1972).

Adults. – General shape: figs. 30 a, 31 a–h. Macropterous to submacropterous. Body surface stramineous to yellowish brown, rather shiny; posterior  $\frac{1}{3}$  of pronotum usually darker of variable extension, but not reaching anterior  $\frac{1}{3}$  (figs. 31 e–h).

Preocular tubercles double; juga of males elongated, parallel, digitiform, surpassing clypeus by 1.1–1.3 times the length of the eye (figs. 29 a, c), those of females only half the length (fig. 29 b), slightly converging anteriorly. Antennae stramineous to yellowish brown, more or less darkened apically; third segment 0.35–0.45 times as long as the diameter and 1.0–1.2 times as long as the fourth segment. Rostrum reaching slightly beyond procoxae. Pronotum 1.35–1.50 times as wide as its median length, regularly curved in profile, slightly sloping in macropterous forms (fig. 30 b), less in submacropterous ones; pronotal carinae as in *P. variable*; marginal laminae very narrow, uniseriate even anteriorly, lateral margin converging anteriorly, sinuate at middle. As far as darker coloration is present, it contrasts strongly with the basic pale color. Hemelytra 1.2–1.7 times as long as their maximum width, distinctly surpassing (macr.) or reaching (submacr.) the apex of abdomen. Metasternum longer than its width (fig. 29 d). Male parameres fig. 29 f.

Length: 2.0–2.75 mm; antennal segments I+II:III:IV = 0.18–0.22:0.17–0.24:0.17–0.20 mm; rostral segments I:II:III:IV = 0.12:0.11:0.07:0.19 mm.

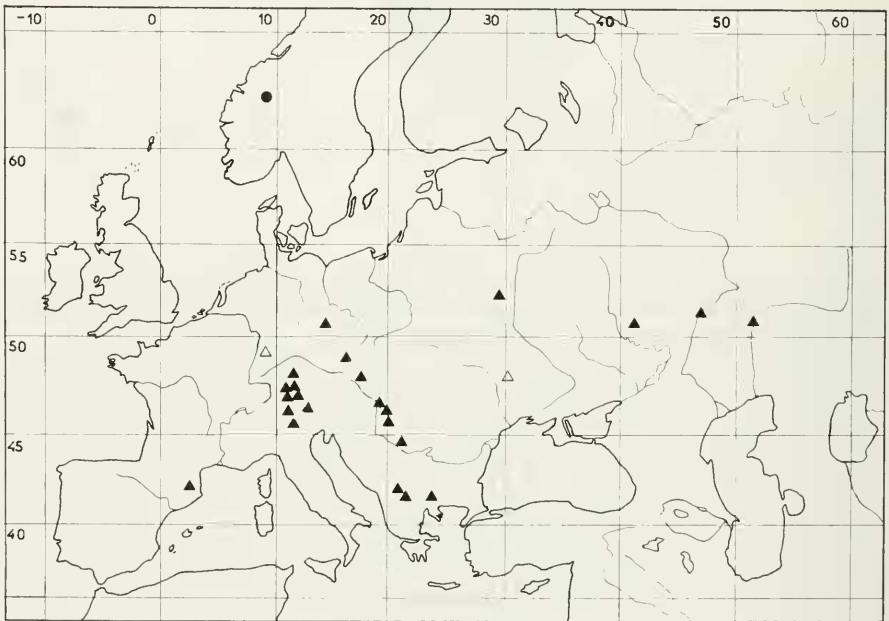
Width: across hemelytra 1.0–1.20 mm.



This species differs from *P. variabile* and *P. unicolor* by the usually characteristic darkened pronotum and its shape seen in profile; from *P. variabile* further by the smaller size and its narrower marginal laminae and on an average shorter antennae; from *P. unicolor* further by longer pronotal carinae. From *P. pupula* it can be differentiated by its more shiny surface, its finer reticulation and the lack of a brachypterous from which is the most frequent one in the latter.

Fifth instar nymph. – Referring to our observations on a specimen from eastern Pyrenees. – Oblong ovate. Jugal slightly surpassing clypeus in female. Rostrum reaching to anterior margin of mesosternum. Antennae about as long as the diatone, relative length of segments I:II:III:IV = 3:4:5:7. Marginal laminae already delimited. Dorsal median line of abdomen without tubercles. Length: 1.8 mm, width: diatone 0.48 mm, abdomen 0.95 mm.

Ecology. – This *Piesma* inhabits sandy, xerothermic and sometimes saline localities; it is allied to several *Caryophyllaceae*. In Hungary it was found on *Silene borystenica* (GRUNER) WALTERS (= *parviflora* EHRH.)<sup>18</sup> as mentioned by HORVÁTH (1888) and also on *Dianthus serotinus* W. & K. (VÁSÁRHELYI, pers. comm.). In Czechoslovakia, ŠTYS (pers. comm.) collected the species on *Silene otites* (L.) WIBEL. In North Tyrol and South Tyrol (Italy) it lives on *Petrorhagia (Tunica) saxifraga* (L.) LINK (HEISS 1971, 1972); nymphs of



Map 7: Distribution of *Piesma silenes* (triangles) and *P. unicolor* (circle) in the Western Palearctic Region.

18 "*Otites parviflora*" mentioned from Ukraine by PUTSHKOV is very probably the same plant (STEHLÍK 1979).

different instars collected from the latter plant have been successfully reared, and feeding has been observed, on *Silene acaulis* L. (EH). On the plateau of Cerdagne in the French Eastern Pyrenees, its host plant is *Dianthus pyrenaicus* POURRET (= *attenuatus* SM.) (MAGNIEN et al 1979). All these *Caryophyllaceae* are closely related.

Adults have been collected between April and September, also in November and February; they hibernate.

In Cerdagne, numerous adults and nymphs of different instars were present in mid-July 1977 and 1978 beneath the host plants; most of the adults were submacropterous and only very few macropterous. The populations observed in South Tyrol at the end of September 1972 showed the same characteristics.

Distribution (Map 7). – *Piesma silenes* occurs in Southern and Central Europe and in Kazakhstan; it can be found at low altitude as well as in the mountains up to 2000 m and is known only from scattered localities.

France. Eastern Pyrenees: plateau of Cerdagne, Estavar, alt. 1300 m, 24–25 VII 1977, 14 VII 1978, numerous! (MAGNIEN et al., 1979). – Italy. Alto Adige: Montan near Ora, 1 V 1955 (WOHLMANN leg.), Castelfeder, 21 VI 1957 (HERNEGGER leg.), id. 23 IX 1970, numerous (HEISS leg.); env. of Bressanone, VI, VIII et IX 1959 to 1967 (PEEZ leg.); Val Venosta: Silandro, 1968 (TAMANINI leg.), S. Martino, 15 VIII 1976, (id.); Laces, Piani di Santa Anna, alt. 1000 m, 18 VII 1975 (TAMANINI leg.). – Germany (FRG). Baden-Württemberg: Sandhausen, X 1961, 2 ex. (SCHIK leg.; BURGHARDT & RIEGER 1978); Upper Bavaria: Ascholding, Emerkofen, 1 ex. (FREUDE leg. > M. Mu!, HEISS 1971). – Austria. North Tyrol: Klarerhof near Innsbruck 12 IV 1954 (PECHLANER leg.), Zirl II, IV, V, VII, XI 1959 to 1970 (KAPPELLER!, HERNEGGER!, HEISS!), Landeck, 11 IX 1960 and 25 VII 1961 (KAPPELLER leg.). – Czechoslovakia. Bohemia: Střekov pr. Ústí n. L., III 1951 (STREJČEK leg. > coll. ŠTYS!; ŠTYS 1963); Southern Moravia: Pouzdřany 26 VII 1941, (HOFFER leg. > USNM, under the name *variable!*); Southern Slovakia: Čenkov, 22 V and 17 VI 1958 (STEHLÍK leg.; STEHLÍK 1979). – Hungary. Central plain. Env. of Budapest!; Kécskemét! (type-series); Szeged!; Gyón!; probably not rare. – Yugoslavia. Vojvodina: Duplaj (M. Bu!); Macedonia: Veles, 23–25 V 1955 (SCHUBERT leg. in coll. ECKERLEIN > M. Gev!); Popova Šapka, env. of Tetovo, alt. 1800–2000 m, 6–8 VIII 1965 (M. Am!). – Bulgaria. Southwest: Bansko, 19 VII 1973 (ŠTUSÁK leg.). – European Russia. Bielorrussia: Bobruysk, 1–20 VII 1929 (GITTERMANN leg. > M. Le!); Voronezh, 28 III 1938 (KORINEK leg. > M. Le!); Saratov (M. Le!); Ukraine: Uman (PUTSHKOV 1974).

Extension in Asia. Eastern Kazakhstan: Janvartsevo, banks of the river Ural, 11 IX 1949 (KIRITSHENKO leg. > M. Le!); Eastern Kazakhstan, Karaganda, Zhana-Arka (PUTSHKOV, l.c.).

Note: The indication from Turkey by HOBBERLANDT (1955) concerns *P. salsolae!*.

## 8. *Piesma (Parapiesma) unicolor* WAGNER, 1954

*unicolor* WAGNER, 1954 a: 40, holotype (♂, Norway) M. Lu!

STICHEL 1957: 38.

Adults. – General shape: submacr. fig. 32 a, macr. fig. 32 b. Macropterous and submacropterous forms known. Body surface rather uniformly brown, olive-green or reddish-brown. Preocular tubercles double. Juga of males parallel, surpassing the clypeus by a length equal to that of the eye (fig. 33 a), those of females shorter  $\frac{1}{3}$  or  $\frac{1}{2}$  of this length, slightly converging anteriorly (fig. 33 b). Antennae yellowish to brown, third segment as long as  $\frac{1}{3}$  of the diatone and only slightly longer than the fourth segment. Rostrum reaching middle of mesosternum. Pronotum 1.4–1.5 times as wide as its median length, in profile sloping anteriorly (fig. 32 c), carinae very short, sometimes only visible along the cal-

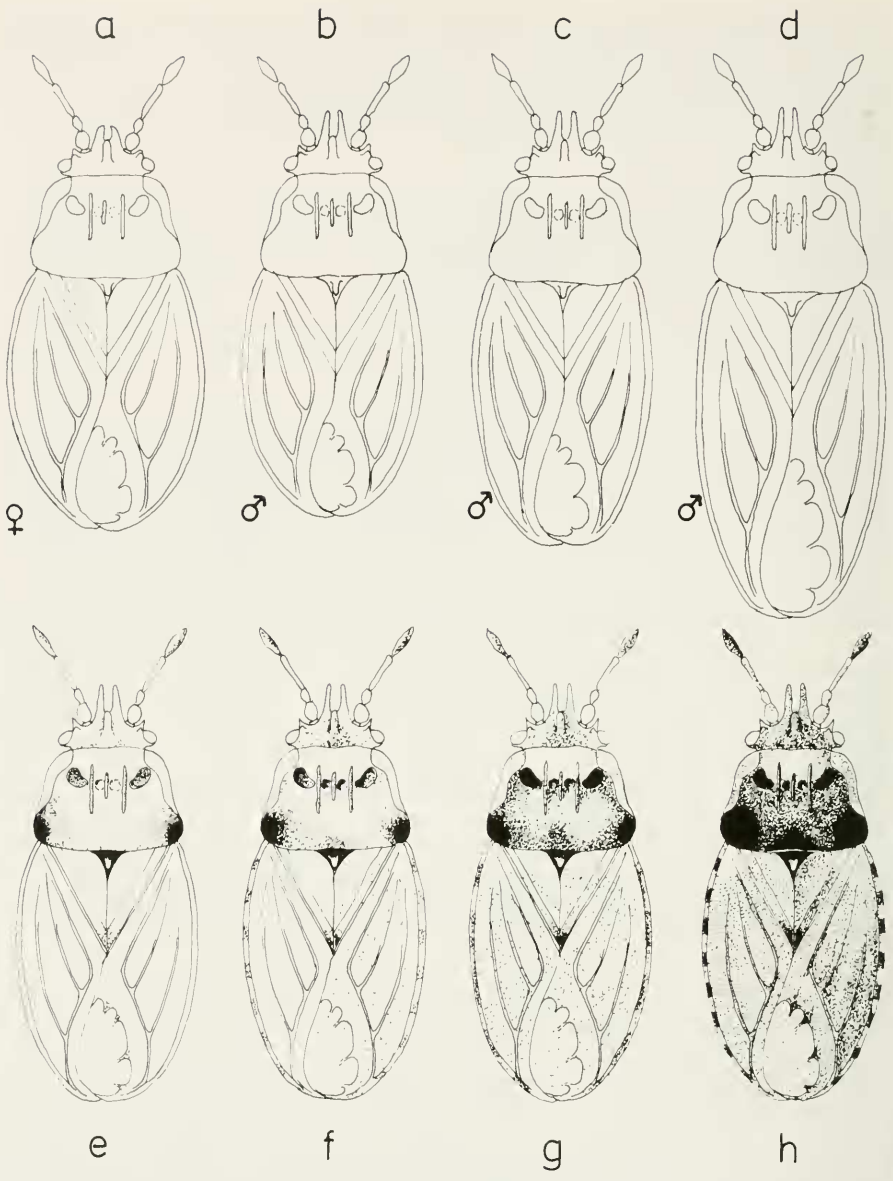


Fig. 31: *Piesma silenes*; a–d, wing polymorphism: a, ♀, submacropterous; b, ♂, submacropterous; c, ♂, submacropterous with more developed membrane; d, ♂, macropterous; e–h, variability of melanism. – (after HEISS, 1972).

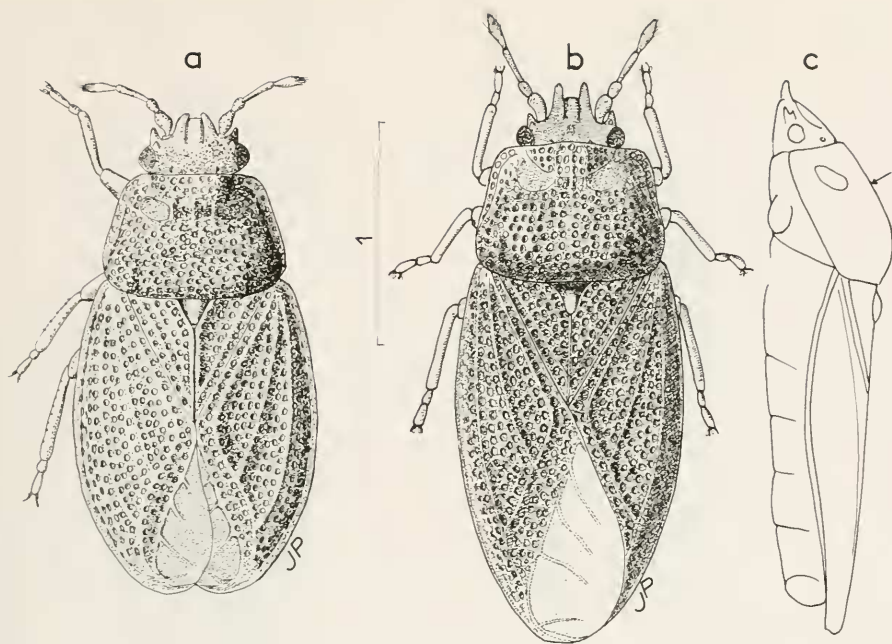


Fig. 32: *Piesma unicolor*. – a, ♀, submacropterous (allotype); b, ♂, macropterous (paratype); c, id., lateral view. – Scale in mm. – (Original).

losities, the median one even obliterating. Marginal laminae narrow, uniseriate, lateral margin of pronotum subrectangular or slightly converging anteriorly, feebly sinuate at middle. Hemelytra 1.2–1.5 times as long as their maximum width, slightly surpassing (macr.) or reaching (submacr.) the apex of abdomen; costal laminae barely developed. Metasternum longer than wide.

Length: macr. 2.65 mm, submacr. 2.1–2.3 mm; antennal segments I:II:III:IV = 0.12:0.09:0.18:0.17 mm.

Width: across hemelytra 1 mm.

This species seems to be differentiated from *P. variabile*, *P. silenes* and *P. pupula* by the very short pronotal carinae and its uniformly brownish color. These characters are based on the type-series and should be confirmed after discovering further populations.

Ecology and Distribution. – This species is only known from the type-series of about fifty specimens which have been collected in Norway, province of Opland, at Dovrefjeld, lat. 62° N, alt. 975 m, VII 1953, by SJÖBERG and HELLÉN (Map 7). It was found in a forested area consisting of birches at the bank of a small river, on *Silene acaulis* L., which might also be the host plant.

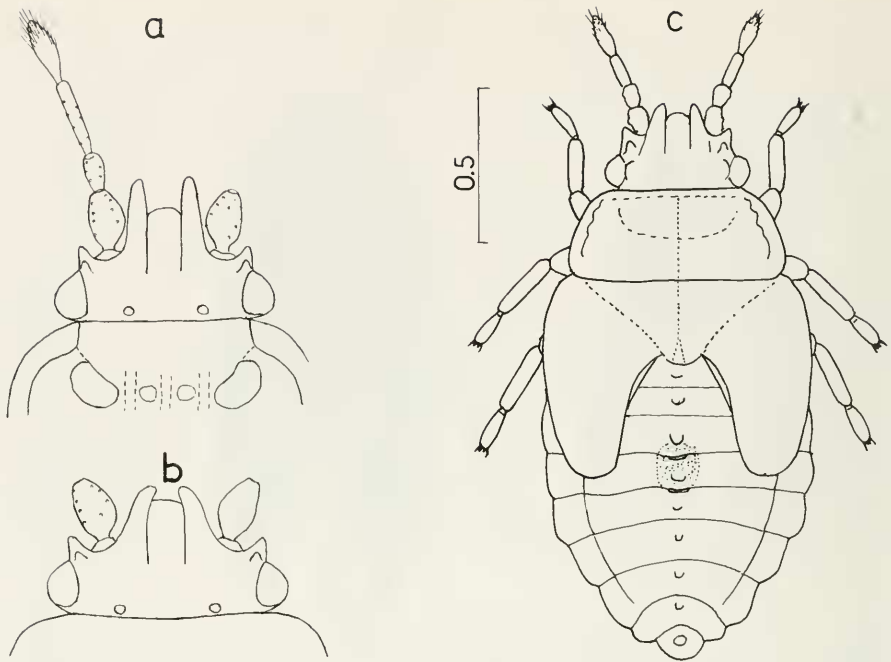


Fig. 33: a, b, *Piesma unicolor*. – a, ♂, head (holotype); b, ♀, head; c, *P. pupula*, nymphal instar V (France: Eastern Pyrenees). – Scale in mm. – (Original).

### 9. *Piesma (Parapiesma) pupula* PUTON, 1879<sup>19</sup>

*luteolus* FIEBER in litt. (*Zosmenus*); *-pupula* PUTON, 1879 a: 297, lectotype (♂, brach. Corsica) M. Pa!, *-ellipticum* WAGNER, 1957: 318, holotype (♂, brach. Pyrenees) coll. WAGNER > M. Hg!.

PUTON 1879 b: 86; HORVÁTH 1906: 8; STICHEL 1957: 40; HEISS & PÉRICART 1975: 528 (synonymy, type- material).

Adults. – General shape: brach. fig. 34 a, macr. fig. 34 b. Usually brachypterous, very rarely macropterous. Body surface stramineous, reddish-yellow, yellowish-brown or greyish-brown, unicolorous or with pronotum darkening posteriorly and hemelytra showing darker spots on costal laminae. Surface slightly mat, reticulation larger than in the closely related species, veins of hemelytra more prominent mainly in the specimens from the Pyrenees. Preocular tubercles double. Juga of males subparallel surpassing the clypeus by 0.5–1.0 times the length of the eye (figs. 35 a, b), those of females shorter, reaching 0.25–0.40 times the length of the eye beyond clypeus (figs. 35 c, d, e). Antennae

<sup>19</sup> The specific name *pupula* being a substantive does not have to correspond grammatically with the generic name *Piesma* which is neutral; the spelling *pupulum* as proposed by DRAKE & DAVIS (1958), PÉRICART (1974), HEISS & PÉRICART (1975) is therefore incorrect. The authors thank Mr. G. SEIDENSTÜCKER for this pertinent remark.



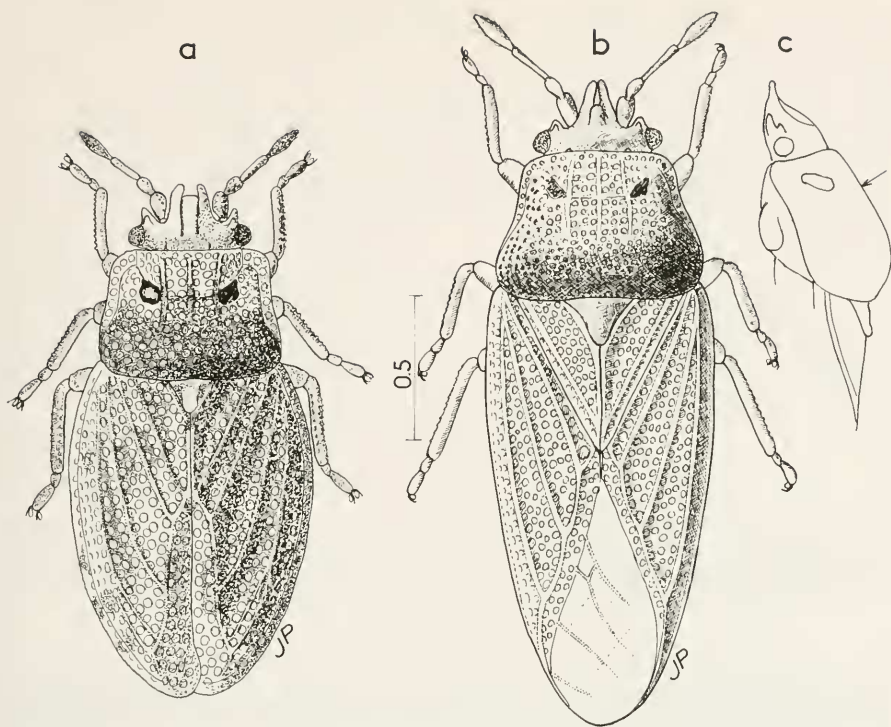


Fig. 34: *Piesma pupula*. – a, ♂, brachypterous (holotype); b, ♂, macropterous specimen (Eastern Pyrenees); c, id., lateral view. – Scale in mm. – (Original).

uniformly pale or slightly darkening apically, third segment short, 0.28–0.37 times as long as the diatone and about 0.9–1.0 times as long as the fourth segment. Rostrum nearly reaching middle of mesosternum. Pronotum 1.4–1.7 times as wide as its median length; in profile gibbously elevated posteriorly and sloping to anterior margin in macropterous forms (fig. 34c), less in brachypterous forms; the three carinae reach slightly beyond middle or to the posterior  $\frac{1}{3}$ , rarely in some brachypterous specimens to the posterior margin. Marginal laminae narrow, uniseriate, lateral margin of pronotum converging anteriorly and slightly sinuate at middle. Hemelytra 1.6–1.9 times as long as their maximum width and distinctly surpassing the apex of abdomen in macropterous forms; 1.2–1.4 (male) or 1.1–1.3 (female) times in brachypterous forms, which are entirely reticulate, not having a membrane. Metasternum distinctly longer than wide (fig. 35f). Male parameres: fig. 35g.

Length: macr. 2.25–2.50 mm, brach. 1.80–2.20 mm; antennal segments I:II:III:IV = 0.10:0.07:0.13–0.17:0.16–0.18 mm; rostral segments I:II:III:IV = 0.07:0.035:0.025:0.10 mm.

Width: across hemelytra 0.87–1.08 mm.

The brachypterous form of this species can hardly be confused with other species, due to the absence of membrane; this character is only shared by *P. kolenatii rotundatum*,

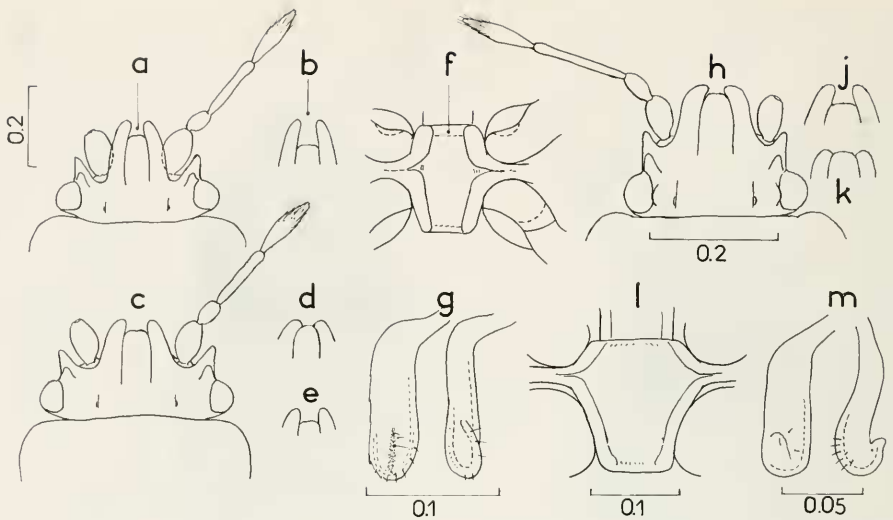
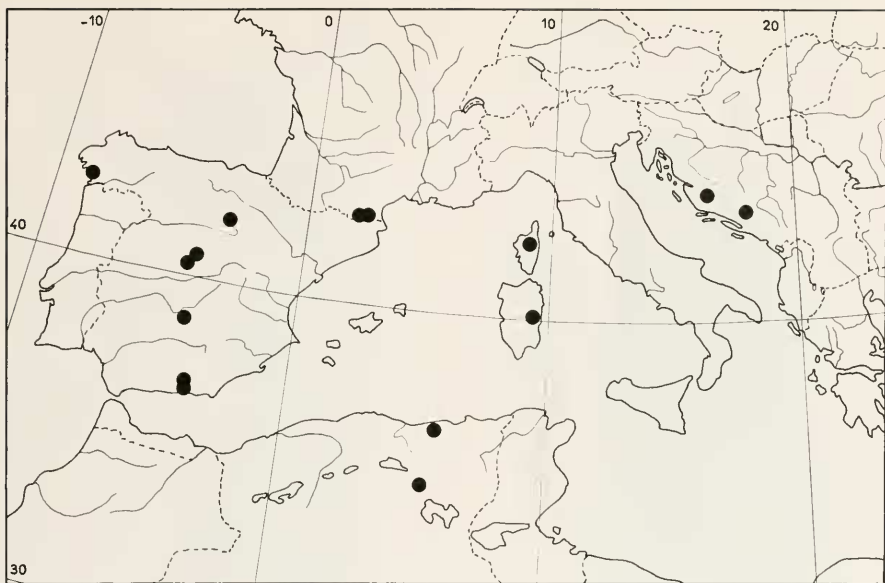


Fig. 35: a-g, *Piesma pupula*: a, ♂, head, dorsal view; b, id., other specimen; c, ♀, head, dorsal view; d, e, id., other specimens; f, metasternum; g, left paramere. – h-m, *Piesma tenellum*: h, ♂, ("Turcomania"), head, dorsal view; j, id., other specimen; k, ♀, jugal appendices; l, ♂, metasternum; m, right paramere. – Scale in mm. – (Original).

but the pronotal carinae of the latter species mostly reach their posterior margin and its marginal laminae are much wider. The macropterous form of *pupula* can be distinguished by the very small size, the slightly mat surface, and the third antennal segment, which is at most as long as the fourth segment.

Fifth instar nymph (figs. 9c, d; 33c). – Referring to own observations on material from French Eastern Pyrenees. Ovate, elongate (male); slightly wider (female). Body surface finely granulate. Juga surpassing the clypeus by the length of their diameter in males, those of females reaching or passing only slightly beyond clypeus, not converging anteriorly. Antennae about as long as the diatone, relative length of segments I:II:III:IV = 3.5:3.2:4.5:7. Rostrum reaching beyond middle of mesosternum; relative length of segments I:II:III:IV = 5:4:4:8. Pronotum 2.5 times as wide as its median length, marginal laminae clearly delimited. Hemelytral lobes reaching middle of tergite IV, the alar lobes almost completely concealed by the latter (the specimens observed are probably brachypterous). Lateral margin of urites IV to VIII convex, projecting. The median line of tergites I–VIII bears small tubercles which are more prominent on tergite III; their length is equal to their basal diameter. Length: 1.6–1.8 mm; width: diatone 0.47 mm, abdomen 0.85 mm.

Ecology. – This *Piesma* is allied to *Herniaria glabra* L. (*Caryophyllaceae*) as *P. variabile*, growing on sandy exposed soils. Adults have been collected from June to August but also in November. In the French Eastern Pyrenees adults occurred together with nymphs of different instars in June–July 1974, and July 1977–78; most of them were brachypterous (MAGNIEN et al., 1979). One of the authors (JP) has observed in Spain, provinces of Madrid (Escorial) and Burgos, at the beginning of June 1981, only brachypterous adults, a number of them in copulation.



Map 8: Distribution of *Piesma pupula*.

Distribution (Map 8). – *Piesma pupula* represents a Western Mediterranean element known from Southern France, Spain, Corsica, Sardinia, Yugoslavia and Algeria.

France. Eastern Pyrenees: Col de Millières, alt. 800 m, 31 VII–2 VIII 1956, numerous (WAGNER et WEBER leg.!: types of *ellipticum*); id, VI–VIII 1974 HEISS & PÉRICART leg.!). plateau of Cerdagne, Estavar, alt. 1300 m, 24–25 VII 1977 (PÉRICART leg.!), id, 13 VII 1978 (MAGNIEN et PÉRICART leg.!). MAGNIEN et al. 1979). Corsica; “Corse” (coll. PUTON > M. Pa!: types of *pupula*); Mte. Cinto, Pens, 24 VII 1955 (ECKERLEIN leg. > M. Gev!). – Sardinia. Mte. Gennargentu (DODERO leg.!: SINGER & MANCINI 1938). – Spain. Prov. of Pontevedra: El Grove, 6 VIII 1953 (W. STEINER leg. > U. Md!); Prov. of Burgos, Sierra de la Demanda, Puerto del Manquillo, alt. 1400 m, 10 VI 1981 (PÉRICART leg.!). Segovia: La Granja (div. coll.!: GONZALEZ 1948); Salamanca: Ciudad Rodrigo 25 VI 1983 (PÉRICART leg.!). Madrid: Cercedilla (IEM!; GONZALEZ l.c.), El Escorial (div. coll.!), id., 4 VI 1981 (PÉRICART leg.!), Valdemartin, XI 1974 (leg.? > IEM!); Ciudad Real: Pozuelo de Calatrava (M. Bu!; GONZALEZ 1948); Granada: Lanjaron (GOMEZ MENOR leg. > USNM!), Sierra Nevada at Mt. Veleta (alt. 2500 m, northern slope), 29 VII 1959 (H. H. WEBER leg.!: WAGNER 1960.). – Yugoslavia. Herzegovina: Nevesinje (M. Bc!, BM!); Croatia: Dalmatia, Knin, 26 VI–7 VII 1935 (Mc GILLAVRY leg. > M. Am!). – Algeria. Biskra, 1 ex. (coll. PUTON > M. Pa!; PUTON 1879 b); Petite Kabylie: Mt. Babor, V 1901 (De VAULOGER leg., in coll. RIBAUT > M. Pa!).

#### 10. *Piesma (Parapiesma) tenellum* HORVÁTH, 1906

*tenellum* HORVÁTH, 1906: 8, lectotype (♀, macr., Turkestan) M. Bu!

Adults. – General shape: figs. 36 a, b. Macropterous or brachypterous. Elongate, of uniformly pale yellowish-green color; eyes pigmented; fourth antennal segment darker. Preocular tubercles double. Jugs relatively short, slightly surpassing the clypeus in

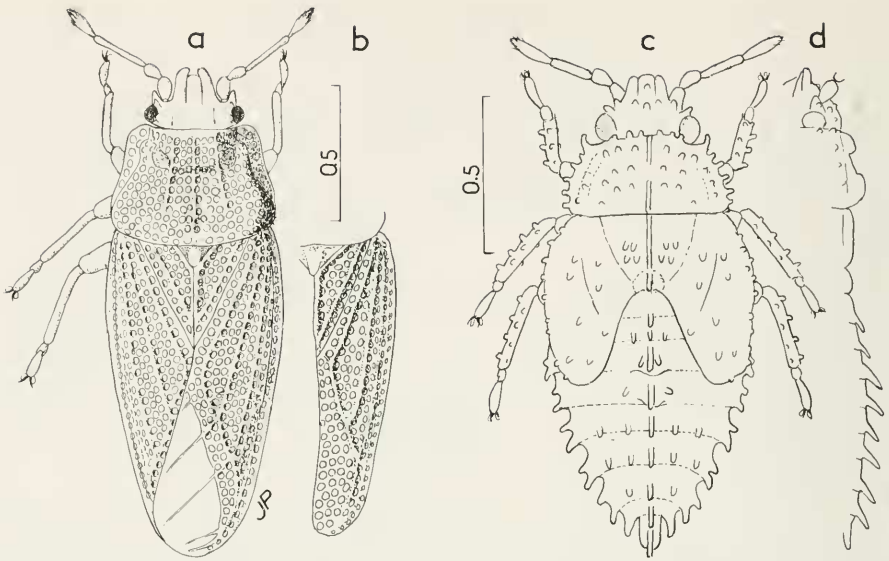


Fig. 36: *Piesma tenellum*. – a, ♂, macropterous (Middle Asia); b, ♂, brachypterous; c, d, fifth instar larva (Iraq). – Scale in mm. – (Original).

males (figs. 35 h, j) or only reaching apex of clypeus in females (fig. 35 k). Antennae slender, third segment 0.5–0.6 times as long as the diatone and 1.2–1.3 times as long as the fourth segment. Rostrum reaching middle of mesosternum. Pronotum 1.4–1.5 times as wide as its median length, the three carinae distinctly developed on the anterior  $\frac{2}{3}$ , its median one sometimes reaching the posterior margin; humeral callosities marked; marginal laminae developed on anterior  $\frac{2}{3}$ , uniseriate with a second row of areolae anteriorly; lateral margins only slightly sinuate at middle. Hemelytra 1.7–1.8 times as long as their maximum width (macr., brach.); membrane of macropterous forms surpassing the apex of abdomen; clavus distinct also in brachypterous forms. Metasternum remarkably wide (fig. 35 l); Male parameres: fig. 35 m.

Length: 1.6–1.8 mm, antennal segments I+II:III:IV = 0.14:0.19:0.15 mm; rostral segments I:II:III:IV = 0.10:0.075:0.05:0.18 mm.

Width: across hemelytra 0.65 mm.

Morphologically isolated species, easy to recognize.

Ecology. – This species lives on *Chenopodiaceae*. R. LINNAVUORI (in litt.) has collected it in Iraq and Arabia exclusively on *Cornulaca leucantha* CHARIF et AELLEN; it has been found in Turkmenistan on *Horaninovia minor* SCHRENK.

Fifth instar nymph: figs. 36 c, d. – Referring to our observation of one single specimen from Iraq. Ovate oblong, pale yellowish. Tibiae and dorsal side of body, including hemelytral pads, covered with rather long, blunt tubercles, those on medial line of abdomen (one on each tergite I to VIII) conical and more prominent. Ventral side finely tuberculate. Medial carina of pronotum lowered at middle; lateral margins denticulate with 5–6 tubercles. Lateral margins of abdominal urites II to VII bearing two tubercles, one at the

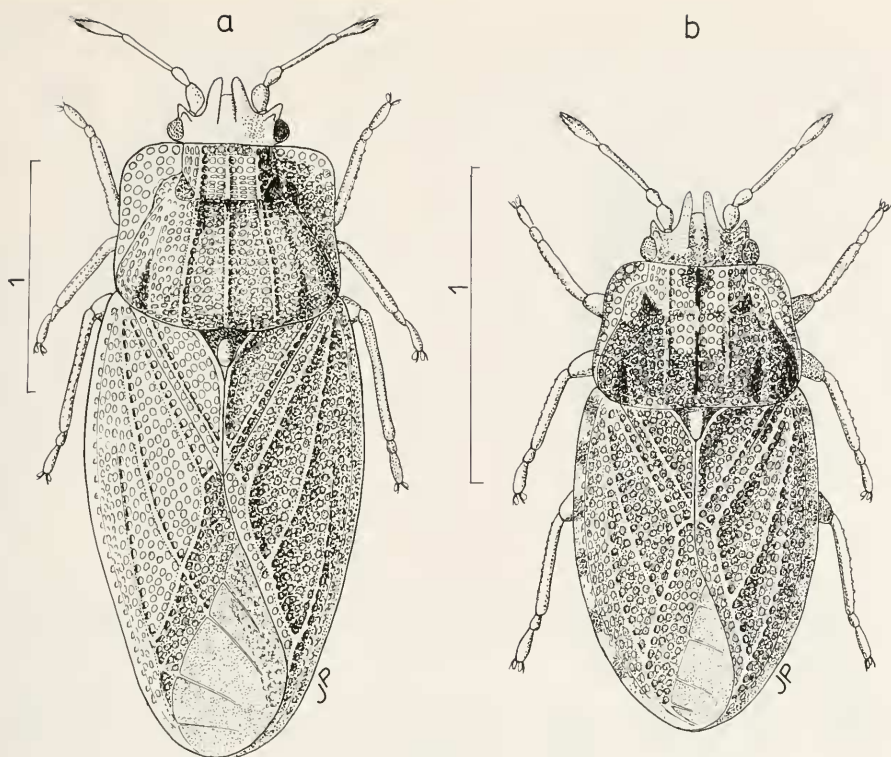


Fig. 37: *Piesma kolenatii kolenatii*, a, ♀, (holotype from Transcaucasia); b, *P. kolenatii atriplicis*, ♂, subbrachypterous (Southern Russia). – Scale in mm. – (after HEISS & PÉRICART 1975).

middle and the other projecting at the posterolateral angle. Juga not surpassing the clypeus. Antennae 1.15 times longer than the diatone, relative length of segments I:II:III:IV = 3:3:6:7. Rostrum reaching the anterior third of mesosternum.

Length: 1.50 mm; diatone 0.36 mm, abdomen 0.70 mm.

Distribution. – The area of distribution of *P. tenellum* is certainly an extended one but still insufficiently known; it includes Iraq, Middle-Asia and Saudi Arabia.

Iraq: Al Anbar, Anah Quaim, 9 X 1979 numerous ex. (LINNAVUORI leg.!); Baghdad, IV–V and VIII 1980, some ex. (id.!). – Southern Kazakhstan or Uzbekistan: “Turcomania” (J. SAHLBERG leg.: type series!). – Turkmenistan: Repetek, 15 VI 1976 (KAPLIN leg. > M. Le!). – Saudi Arabia: Hofuf, Al Hasa Distr. (LINNAVUORI leg.!).



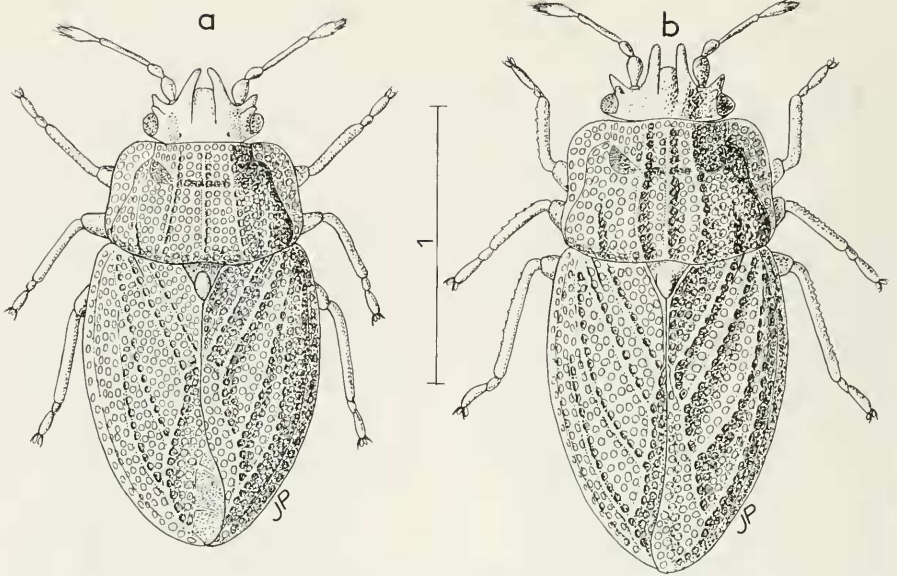
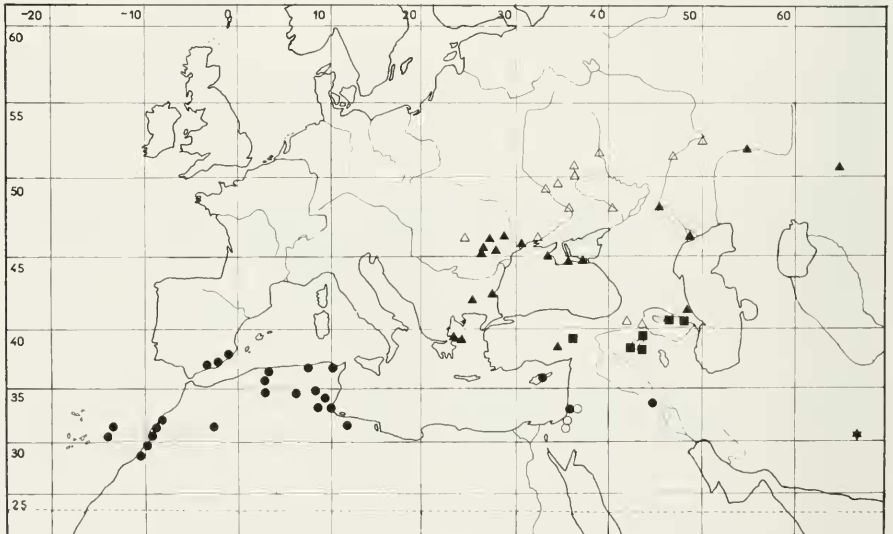


Fig. 38: *Piesma kolenatii atriplicis*, a, ♂, subbrachypterous, with reduced membrane (Greece); b, ssp. *rotundatum*, ♂, brachypterous (Libya). – Scale in mm. – (a, original; b, after HEISS & PÉRI-CART, 1975).



Map 9: Distribution of *Piesma kolenatii* in the Western Palearctic Region. – Triangles refer to ssp. *atriplicis*, circles to ssp. *rotundatum* and squares to the nominal subspecies, which is only known from Caucasus and Central Anatolia. The star indicates the locality in Pakistan, where an aberrant population of ssp. *rotundatum* has been found.

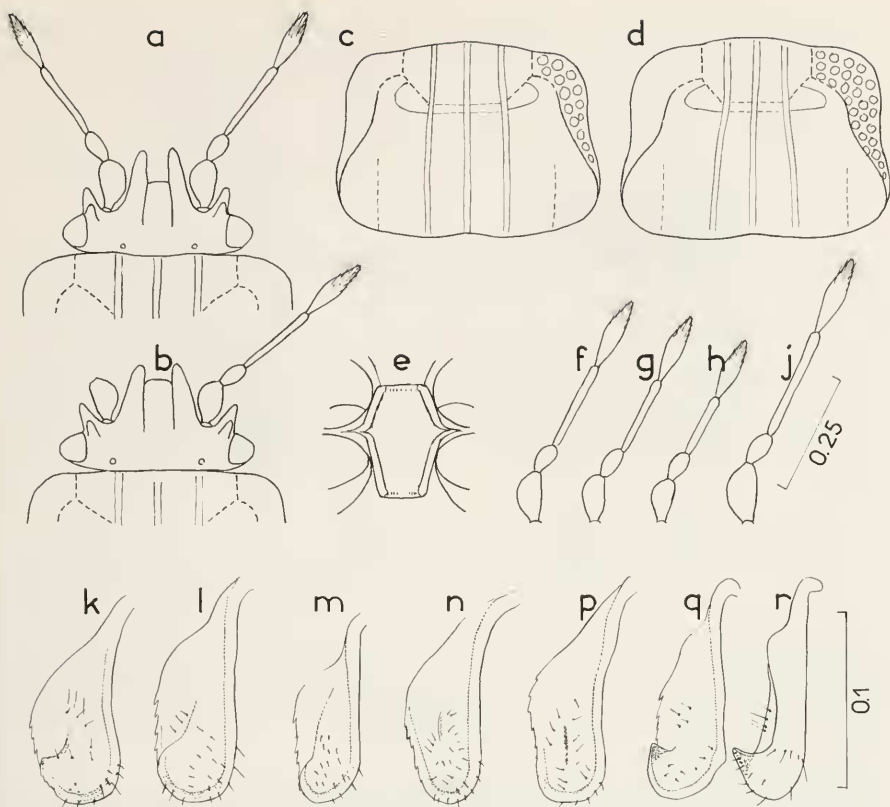


Fig. 39: a, *Piesma kolenatii rotundatum*, ♂ (Libya), head, dorsal view; b, id., ♀; c, ssp. *rotundatum*, pronotum of brachypterous specimen (Algeria: Biskra); d, ssp. *rotundatum*, pronotum of ♀ (holotype); e, metasternum of ssp. *rotundatum* (Algeria: Annaba); f, antenna of ssp. *atriplicis*, ♂ (Southern Russia); g, id., ssp. *rotundatum*, ♂ (Algeria); h, id., ♂ (Canary Islands, "minimum"); j, id., ssp. *kolenatii*, ♂ (holotype: Transcaucasia); k-r, left paramere, dorsal view: k, ssp. *atriplicis* (Romania); l, id., (Greece); m, id., (Southern Russia); n, id., ssp. *rotundatum* (Libya); p, id., (Canary Islands); q, r, id., *Piesma kochiae*. – Scale in mm. – (Original).

## 11. *Piesma* (*Parapiesma*) *kolenatii* (FIEBER, 1861)

### 11a. *Piesma kolenatii kolenatii* (FIEBER)

*laportei* KOLENATI, 1857: 423 (*Zosmenus*) (nec FIEBER, 1844) type? (Caucasus, Transcaucasia); – *kolenatii* FIEBER, 1861 (*Zosmenus*) (nec JAKOVLEV, nec auct.) holotype (♀, macr., Transcaucasia) M. Le!; – *caucasicum* PÉRICART, in litt. 1973.

HEISS & PÉRICART 1975: 531 et fig. 4a.

Adults. – General shape: macr. fig. 37a; Macropterous and brachypterous forms known. Antennae: fig. 39j; third segment 0.5 times as long as the diatone. Pronotum 1.4–1.55 times as wide as its median length, posterolaterally elevated, with three longitu-

dinal carinae reaching posterior margin; marginal laminae very wide on anterior  $\frac{2}{3}$ , with 3 rows of areolae as in fig. 39d; hemelytra 1.7 times as long as their maximum width and surpassing the apex of abdomen in macropterous forms; those of brachypterous forms without membrane and entirely reticulate, only 1.15 times as long as wide and reaching apex of abdomen, clavus not differentiated.

Length: macr. 2.75 mm, brach. 2.0–2.35 mm; antennal segments I:II:III:IV = 0.11:0.085:0.22–0.26:0.19 mm.

Width: across hemelytra macr. 1.25 mm, brach. 1.10–1.25 mm.

Ecology and Distribution. – This nominal subspecies feeds on *Chenopodiaceae*: *Suaeda*, *Chenopodium*.<sup>20</sup> It is distributed in Caucasus, Transcaucasia and Anatolia (Map 9).

Caucasus: “Kaukas”, 1 ♀ brach. (LEDER leg. in coll. REUTER > M. He!, as *rotundatum*, spec. type n° 9619!). – Transcaucasia. Azerbaidzhan: “Elisabethpol” (= Kirovabad), 1 ♀ macr. (holotype); Yevlakh, near river Kura, 14 VIII 1949, 2 ♀ brach. (BOGATSHEV leg. > M. Le!). – Anatolia. Armenia: Van, 8 VIII 1977 (EGU!), Nemrud Dağ, 9 VIII 1977, 1 ex. (id.!). Doğubeyazik, 6 VIII 1977, on *Suaeda* sp. (id.!). Cappadocia: Prov. of Kayseri: Bünyan, 13 VIII 1979 on *Chenopodium* sp. (EGU!).

### 11b. *Piesma kolenatii* ssp. *atriplicis* (FREY-GESSNER)

*atriplicis* (BECKER) FREY-GESSNER, 1863: 118 (*Zosmenus*) (nec BECKER 1864) lectotype (♀, Lower-Volga) M. Pa!; – *atriplicis* BECKER, 1864: 488 (*Zosmenus*) type ? (Lower-Volga); – *viridulus* JAKOVLEV, 1871: 5, 6 (*Zosmenus*) lectotype (sub-brach., Astrachan) M. Le!; – *minutus* JAKOVLEV, 1871: 6 (*Zosmenus*) type ? (Astrachan); – *chenopodii* JAKOVLEV, 1874b: 24, 27 (*Zosmenus*) lectotype (♂, macr., M. Le!); – *kolenatii* sensu JAKOVLEV, 1874b et auctt. (nec FIEBER 1861); – *rotundatum* HORVÁTH, 1906: 9 (part); – *kolenatii atriplicis* nov. stat., HEISS & PÉRICART, 1975: 531.

KIRITSHENKO 1951: 238; – STICHEL 1957: 40; PUTSHKOV 1974: 69.

Adults. – General shape: macr. fig. 40a, sub-brach. figs. 37b, 38a. Subbrachypterous, more rarely submacropterous or macropterous. Color very variable, from greenish-yellow to greyish-green etc., surface sometimes unicolorous or more or less dotted with brownish spots on the hemelytra, pronotum darkened on posterior half, its anterior  $\frac{1}{3}$  always pale. Preocular tubercles double. Jugal subparallel and surpassing the clypeus by  $\frac{2}{3}$  times the length of the eye in males, those of females somewhat shorter but very variable in length. Antennae (fig. 39f) pale, except the last segment usually darkened (rarely sometimes also the anterior half of segments II and III darkened), third segment 0.4–0.5 times as long as the diatone and 1.10–1.40 times as long as fourth segment. Rostrum reaching middle of mesosternum. Pronotum 1.4–1.7 times as wide as its median length, with three longitudinal carinae, reaching posterior margin or sometimes ending on posterior elevation of disc in macropterous forms; postero-lateral elevation sometimes forming a longitudinal ridge in some subbrachypterous specimens. Marginal laminae wide with two rows of areolae in the anterior  $\frac{2}{3}$ . Hemelytra 1.4–1.5 (macr.) or 1.2–1.4 times (sub.-brach.) as long as their maximum width; clavus of subbrachypterous forms mostly incompletely delimited, membrane very small, sometimes reduced to a hem (specimens of Greece), posterior wings reaching  $\frac{1}{2}$  abdomen only. Male parameres: figs. 39k, l, m.

20 KOLENATI (1857) indicated as host plants *Boraginaceae* (*Echinospermum*, *Symphytum*), which are at first glance surely erroneous.

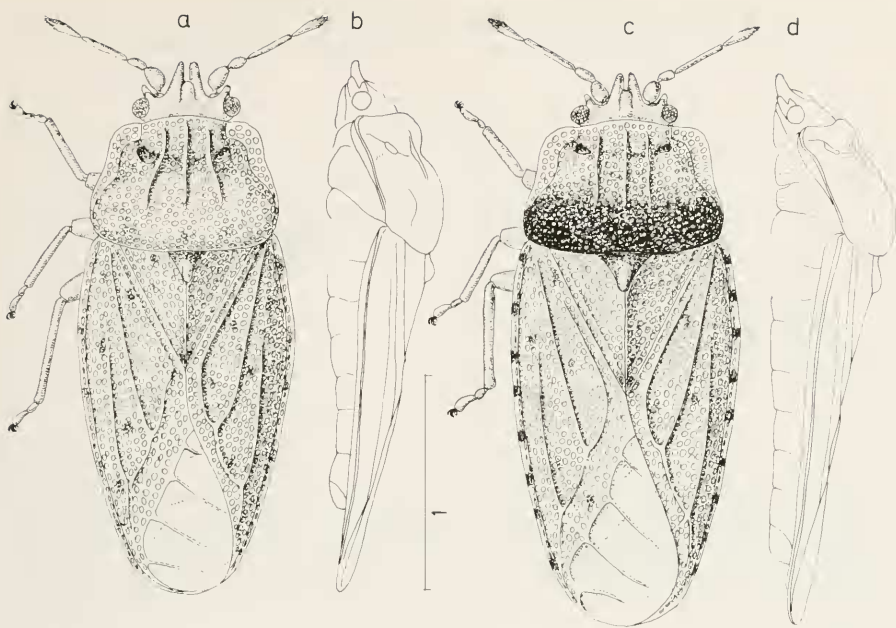


Fig. 40: a, b, *Piesma kolenatii atriplicis*. – a, ♂, dorsal view, macropterous specimen (Southern Russia); b, id., lateral view. – c, d, *P. kerzhneri* n. sp. – c, ♂, dorsal view, macropterous specimen; d, id., lateral view. – Scale in mm. – (Original).

Length: macr. 2.3–2.5 mm, sub-brach. 1.25–2.3 mm, antennal segments I+II:III:IV = 0.16–0.19:0.18–0.24:0.16–0.18 mm; rostral segments I:II:III:IV = 0.11:0.10:0.06:0.24 mm.

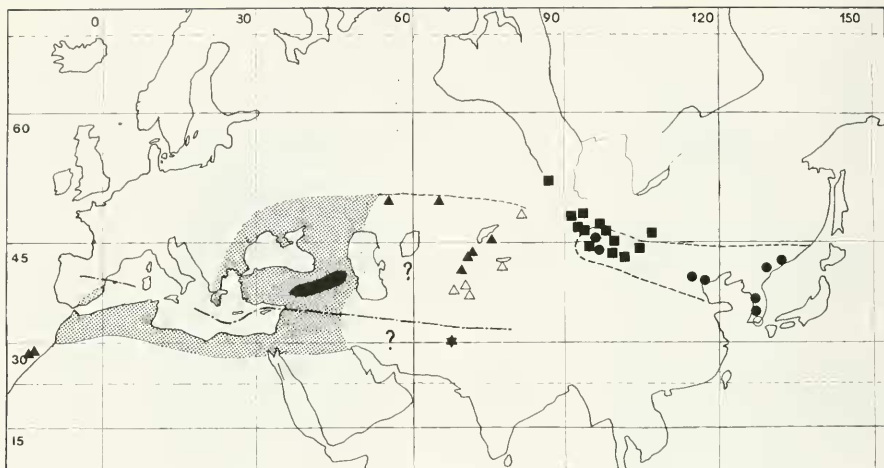
Width: across hemelytra 0.9–1.2 mm.

This subspecies is of very variable shape and probably some more or less distinct populations can be distinguished. *Piesma chenopodii* represents the macropterous form of the region of Astrachan. *P. minutum* and *P. viridulum* correspond to the subbrachypterous form of the same region. The first one is of very small size (1.25–1.50 mm) and its pronotum is darkened posteriorly and pale anteriorly, which resembles *P. silenes*; the second is somewhat larger in size and usually has a unicolored pronotum; intermediate forms also exist.

The macropterous forms of *P. kolenatii atriplicis* with posteriorly reduced pronotal carinae may be confused with *variabile* and *silenes*; they can easily be distinguished, however, by their wider marginal laminae, and the shorter jugs in males.

Note. The subbrachypterous populations found in Greece, with almost completely reduced membrane, seem to present the transitional form between this subspecies and *P. kolenatii rotundatum*, where the dominant form is the brachypterous one.

Egg (figs. 10 e, f). – Referring to PUTSHKOV, 1974. Robust, slightly curved, twice as long as its diameter. Pseudopericulum with 5–6 micropylar processes. Length 0.5 mm; width 0.23 mm. The nymphs are unknown.



Map 10: Palaearctic distribution of *Piesma* species. – The dotted area indicates the region where *P. kolenatii* sensu lato shows a more or less continuous distribution; the triangles mark the findings in Middle Asia. The black area shows the distribution of *Piesma kolenatii kolenatii* (Transcaucasia and East Anatolia). The dotted line separates the distributional areas of the ssp. *atriplicis* (north of it) and ssp. *rotundatum* (south of it). A star marks the locality of the mentioned Pakistanian population. Circles represent *P. josifovi* and squares *P. kerzhneri* n. sp.

Ecology. – According to PUTSHKOV, in Russia this *Piesma* can be found along roadsides, on fallows and saline soils on different *Chenopodiaceae* of the genus *Atriplex*: in Ukraine on *A. hortensis* L. and *A. hastata* L., more rarely on *A. tatarica* L.; in Greece on *A. balimus* L.; in the littoral zones and in Kazakhstan on *A. cana* C. A. MEY. and *A. verrucifera* M. BIEB. (KERZHNER & JACZEWSKI, 1964).

Distribution (Maps 9, 10). – The distribution of *P. kolenatii* ssp. *atriplicis* is pontic, extending eastwards across the saline steppes of Kazakhstan to Tadzhikistan and Kirghizia.

Romania. Transylvania: Dumbrăveni (E. SCHNEIDER 1976); Moldavia: valley of Barlad (MONTANDON leg. > div. coll.!); Valachia: Plainești (M. Bc), Buzău (USNM!); Dobroudja: Măcin (div. coll.!). – Bulgaria. Env. of Burgas, 6 VI 1971 (JOSIFOV leg. > M. So!; JOSIFOV 1974); Plovdiv, 30–31 VII 1957 (ECKERLEIN leg. > M. Gev.! (JOSIFOV 1964, reported as *rotundatum*). – Greece. Attica (M. He!; HORVÁTH 1906: *rotundatum*), Eleusis (ŠTYS leg.!), Anavyssos, 12 VIII 1958, numerous (ECKERLEIN leg. > M. Gev.), Piraeus (Champion leg. > BM!). – European USSR. Distributed over the whole southern part, north up to Cherkassy, Poltava, Belgorod, Voronezh, Saratov, Kuybyshev and Orenburg! (PUTSHKOV 1974). Moldavia: Kishinev, etc., (HORVÁTH leg. > M. Bu!; HORVÁTH 1894). Odessa!, Krym!, Volgograd! (= Sarepta) (types of *atriplicis*), Astrachan! (types of *viridulum*, *minutum* and *chenopodii*); Caucasus: Derbent!. – Transcaucasia. Armenia (PUTSHKOV, 1974; M. Le!); Azerbaïdžan: Kalagayny 21 V 1933 (LOUKIANOVITSH leg. > M. Le!). – Turkey (Anatolia). Distr. of Niğde: 50 km past Aksaray, 7 VIII 1963 (LINNAVUORI leg.!; LINNAVUORI 1965); distr. of Kars: Sarikamiş (KIRITSHENKO 1918). – Tauria (RETOVSKI leg. > coll. HEISS); – Kazakhstan. Central: region of Lake Aksuat (FORMOSOV leg. > M. Le!); East: region of Lake Zaysan (PUTSHKOV 1974); South: region of Lake Balkash 17 VI 1939 (SHNITNIKOV leg. > M. Le!), Lugovoy 23 VII 1945 (LUBITSHEV leg. > M. Le!). – Uzbekistan. Margelan (M. Bu!; HORVÁTH 1906). – Tadzhikistan. Ayvadh 31 VII 1934 (GUSSAKOSKIY leg.; KIRITSHENKO 1964); Piandzh 7 III 1944 (ARNOLDI leg.; KI-



RITSHENKO l. c.); Ruchan-Barzud, IX 1937 (LOUKIANOVITSH leg.; KIRITSHENKO l. c.); Uyaly 24 V 1944 (KIRITSHENKO leg.). – Kirgizistan. Issik-Kul (sec. PUTSHKOV 1974). – Turkestan. Kok Dshigdè (ALMASY leg. > coll. HEISS).

### 11c. *Piesma kolenatii* subsp. *rotundatum* HORVÁTH

?*atriplicis* sensu STÅL, 1874: 44 (*Zosmenus*) (nec FREY-GESSNER, 1863); – *rotundatum* HORVÁTH, 1906 (part, et sec. lectotypus), lectotype (♀, brach. Algeria), (M. Bu!); – *rotundatum* var. *pygmaea* HORVÁTH, 1906: 9, lectotype (♂, brach., Syria) M. Bu!; – *minimum* WAGNER, 1954c: 7, holotype (♂, brach., Canary Islands) coll. Wagner > M. Hg!; – *kolenatii rotundatum*, nov. stat., HEISS & PÉRICART, 1975: 533. STICHEL 1957: 41 (part.); – RIBES 1974: 79 (synonymy of *minimum*).

Adults. – General shape: brach. fig. 38 b. Macropterous or more frequently brachypterous. Head: figs. 39 a, b. It differs from the subspecies *atriplicis* mainly in the following characters. Antennae usually slightly shorter (fig. 39 g, h), however, the length of the third segment is very variable and 0.33–0.48 times as long as the diatone and 0.9–1.5 times as long as the fourth segment; pronotal carinae usually reach the posterior margin in macropterous forms. Hemelytra of brachypterous forms without membrane.

All specimens we have seen are yellowish-green or stramineous, sometimes with small brown spots. Metasternum: fig. 39 e. Male parameres figs. 39 n, p.

Length: macr. 2.0–2.50 mm, brach. 1.6–2.1 mm; antennal segments I+II:III:IV = 0.18–0.21:0.15–0.23:0.15–0.19 mm.

Width: across hemelytra 0.9–1.2 mm.

The form *minimum* has been described as a distinct species basing on small brachypterous specimens with remarkably short third antennal segment (populations of Canary Islands); similar specimens are found in Southern Spain, North Africa and also in the Near East (forma *pygmaea*).

A population of macropterous and brachypterous specimens from Pakistan differs from North African ones in a more slender habitus, longer antennae and narrower marginal laminae, however, it cannot be clearly separated and is included here.

Fifth instar nymph. – Referring to our observations of a single specimen of Southern Tunisia in rather bad condition. Ovate oblong, of pale green color. The whole body, antennae and legs covered with whitish granules, which are smaller on the abdomen and appendages. A medial prominent tubercle is present on tergites I to VIII dorsally. Juga surpassing the clypeus by a length equal to their diameter, not converging anteriorly (fig. 9 g). Antennae slightly longer than the diatone; relative length of segments I:II:III:IV = 3:2.7:5:6. Rostrum reaching the anterior margin of mesosternum. Length: 1.2 mm; diatone 0.38 mm, abdomen (?0.60 mm).

Ecology. – *Piesma kolenatii rotundatum* has only been found on *Chenopodiaceae* of the genus *Atriplex*: *Atriplex* sp. in North Africa (LINDBERG!, PÉRICART!), *A. halimus* L. in Algeria (ECKERLEIN & WAGNER 1965), Cyprus (LINDBERG, 1948) and Palestine (LINNAVUORI, 1961); *Atriplex* sp. and possibly *Suaeda* in Southern Spain (RIBES, 1974); *Atriplex turcomanica* FISCH. & MEY. in Pakistan (HEISS leg.!).

The annual life cycle of this species in Europe is supposed to be similar to those of other species. In the desert zones of North Africa, the development takes place very early in the season: in 1978 *P. rotundatum* was very abundant in the salty regions of Southern Tunisia at the beginning of May, one could see only adults and rarely some last instar nymphs.

Distribution (Maps 9, 10). – *Piesma kolenatii rotundatum* occurs in Southern Spain, all North Africa and the Near East. It is also present at the Canary Islands, Cyprus, and was found in Western Pakistan. It seems to be allied to saline, subdesert steppes.<sup>21</sup>

Spain. Prov. of Alicante: Villena, 8 IX 1974; Sant Joan d'Alacant 22 V 1975!, Laguna de la Mata, 9 VIII 1973 (RIBES leg.), RIBES & SAULEDA 1979); Nova Tabarca 27 XII 1969 (RIBES leg.!, RIBES 1974); Prov. of Almeria: Tabernas, 1 VI 1981 (PÉRICART leg.!). – Granada: Lanjarón (GOMEZ-MENOR leg. > IEM!). – Morocco. Distributed along the Southern Coast, from Safi to south of Ifni: Safi! (LINDBERG leg.), Essaouira! (PÉRICART leg.), Agadir (ECKERLEIN leg.!), near Oued Draa! and Oued Noun! (LINDBERG leg.). – Algeria. Env. of Beni-Ounif (= Figuig) 6 V 1964, numerous (ECKERLEIN leg.!, ECKERLEIN & WAGNER 1965, reported as *minimum*); Alger (BM!), Boughzoul (ECKERLEIN leg.!, and l. c.), Djelfa (id.!), "Bône" (= Annaba), lectotype of *rotundatum* and div. coll.!, Biskra, 4 ex. macr. (DE BERGEVIN leg. > M. Pa!). – Tunisia. Porto Farina 15 VIII 1962 (LINNAVUORI 1965), Tunis (M. Bu!, M. Ge!, etc.). Abundant in the southern saline steppes: Degache near Tozeur, Gabès, Kebili, etc. IV–V 1978 (PÉRICART leg.!). – Libya. Tripolitania: 60 km east of Nalut, 30 IV 1965 (ECKERLEIN leg.!, ECKERLEIN & WAGNER 1969 reported as *minimum*). – Canary Islands. Fuerteventura: El Jable, 5–8 III 1949 (LINDBERG leg.!), types of *minimum*; Matural, 29 III 1963 (LINDBERG leg.!, LINDBERG & WAGNER 1965); Lanzarote: 1 ex. macr. (REMANE leg.!). – Israel and Jordan. "Jordan" (U. SAHLBERG leg. > M. Bu: types of *pygmaeum*); Ashqelon 2 VII 1958, Deganya 23 VII 1958, Revivim 2 VIII 1958, Tannim 26 VII 1958 (LINNAVUORI 1961). – Iraq. Abu Ghraib near Baghdad 24 II 1958 (REMANE leg. and coll.!). – Cyprus. Larnaka, 25 VI–1 VII 1939 (LINDBERG leg. > M. He!, LINDBERG 1948). – Western Pakistan. Quetta, alt. 1600 m, 2–4 X 1972, macr. and brach. (HEISS leg. and coll.!).

## 12. *Piesma (Parapiesma) kerzhneri* n. sp.

The description is based on a long series of specimens, all from Mongolia. General aspect of macropterous form fig. 40c. Submacropterous forms with variable reduction of membrane are also present.

Head (figs. 40c, d). – Yellowish, eyes brownish. Preocular tubercles double. Juga subparallel, straight, surpassing the clypeus by  $\frac{2}{3}$  times the length of the eye in males and by  $\frac{1}{3}$  times in females; its apices blunt, only slightly bent upwards in males. Antennae yellowish, fourth segment brownish; third segment 0.5–0.55 times as long as the diatone and 1.4–1.55 times as long as the fourth segment. Rostrum reaching  $\frac{1}{3}$  of mesosternum. Ocelli present.

Pronotum yellowish white, sometimes with brownish spots. In males, the posterior  $\frac{1}{2}$ – $\frac{2}{3}$  of the pronotum show a tendency to darken from brownish to black, in such cases the corresponding ventral side is also darkened; 1.45–1.60 times as wide as its median length in males and 1.53–1.68 times in females, with three distinct carinae not reaching the anterior margin and extending to the elevated disc posteriorly. The callous spots anterolateral of the exterior carinae are frequently yellowish as the head. Marginal laminae devel-

21 Note. J. SIMONET (1949) indicated the presence of *P. rotundatum* in Switzerland according to unprecise older literature. This has been repeated by STICHEL (1957). One of the authors (JP) has seen such specimens at the Museum of Natural History at Geneva (local collection), which were correctly identified, but their locality labels (Zurich, leg. FREY-GESSNER; Veyrier, leg. SIMONET, etc.) are unbelievable; the same collection contained *Piesma kochbiae* from Zurich and Argovie (leg. FREY-GESSNER). As these are obviously errors of labeling, *P. rotundatum* has to be removed from the list of Swiss species.

loped on anterior  $\frac{2}{3}$ , flat, with two rows of small but distinct areolae, anterolateral angles rounded, lateral margins converging anteriorly, slightly sinuate at middle.

Scutellum yellow to brown at its base, apex elevated, whitish.

Hemelytra yellowish white to stramineous, mostly with irregular brownish spots and 6 to 10 darker spots on the costal laminae; 1.5–1.7 times as long as their maximum width in macropterous forms and 1.16–1.30 times in submacropterous forms.

Ventral side yellowish with brownish markings; mesosternum frequently black, whitish along the median groove; metasternum wider than its length and than the diameter of the hind coxae (photo 2).

Legs yellowish, femora brownish, claws black.

Pygophore and paramere see photos 27–30.

Length: 2.3–2.6 mm (macr. males), 2.75–3.00 mm (macr. females), 2.0–2.3 mm (submacr.); antennal segments I:II:III:IV = 0.12:0.10:0.26:0.18 in males and 0.12:0.10:0.28:0.20 in females.

Width: 1.0–1.1 mm across hemelytra in males, 1.2–1.3 mm in females.

Ecology and Distribution (Map 10). – This species has been collected by KERZHNER on *Chenopodiaceae* as *Salsola kali* L., *Anabasis brevifolia* C.A.M., *Atriplex sibirica* L. and *Eurotia* sp. in Central Asian steppes.

Holotype ♂ macr. Gorno Altajskaja AO, Kosh-Agach 18 VI 1964 on *Anabasis brevifolia* C.A.M., 15 paratypes from same locality (macr., submacr.); further paratypes are all from Mongolia: Nis. R. Bajdarik Khalka 3 VIII 1926 (KIRITSHENKO leg., 1 ex.); Wpred. Ikhe-Bogdo, Gobi Altai 21 VIII 1926 (KIRITSHENKO leg., 1 ex.); Zentralnij aimak, 5 km S Erdene-Khuduk 21 VII 1967 (EMELJANOV leg., 2 ex.); Gobi Altaj aimak, Shargyn-Gobi, 40 km SW Altai 22–23 VIII 1967 (KERZHNER leg., 30 ex. on *Salsola kali*); S-Gobi aimak, Khongoryn-Els, 60 km WNW Bajan-Dalaja 30–31 VII 1967 (KERZHNER leg., 1 ex.); S-Gobi aimak, 10 km E Kol. Sudzhijn-Khuduk 2 VIII 1967 (KERZHNER leg., 14 ex. on *Atriplex sibirica* L.); S-Gobi Altaj, 66 km SSE Nomgona, near spring 9 VIII 1967 (EMELJANOV leg., 1 ex.); Bajan Khongorsk aimak, Khr. Ikhe Bogdo, 50 km SW Lake Ogor Nur alt., 1700 m, 17 VIII 1967 (ZAJZEV leg., 1 ex.); Ubsunurskij aimak, E shore of lake Urek Nur 15 VIII 1968 (EMELJANOV leg., 1 ex.); Ubsunurskij aimak, Protoka, Airag-Khyrbijsk Nurom 29 VIII 1968 (EMELJANOV leg., 1 ex.); Bajan-Khongorsk aimak, Ur. Dzun, 70 km S Shchine-Dzinst 10–11 VIII 1969 (KERZHNER leg., 4 ex.); Middle Gobijskiy aimak, Gori Delger-Khangaj-Ula 1 IX 1969 (KERZHNER leg., 1 ex. on *Atriplex sibirica* C.A.M.); Gobi Altaj aimak, 12 km S Zogta 15 VII 1970 (KERZHNER leg., 1 ex.); Gobi Altaj aimak, Radn. Khajdzh-Bulak, 60 km SE Bugata 19 VII 1970 (EMELJANOV leg., 1 ex.); Gobi Altaj aimak, 30 km WNW Bidzh-Altaj 21 VII 1970 (KERZHNER leg., 1 ex. on *Eurotia* sp.); Kobd. aimak, Rodn. Narijn-Bulak, Khr. Ikh-Khawtgijn-Nur 24 VII 1970 (KERZHNER leg., 1 ex.); Bajan Khongorsk aimak, 30 km WSW Bajan-Undera 27 VIII 1970 (KERZHNER leg., 1 ex.); S-Gobi aimak, Dzeming-Gobi, 25 km SSW Khajlastyn-Khuduka 20 VI 1971 (EMELJANOV leg., 1 ex.); S-Gobi aimak, Sajr Undyn-Gol, 25 km S G. Khan-Bogdo 23 VI 1971 (KERZHNER leg., 22 ex., one at light); S-Gobi aimak, Urach Udzur-Dzag, 40 km ESE G. Khan Bogdo 24 VI 1971 (EMELJANOV leg., 3 ex.); S-Gobi aimak, 25 km NNE Mt. Agujt-Ula 24 VI 1971 (EMELJANOV leg., 2 ex.); S-Gobi aimak, Urohd. Dzurgan-Mod., 30 km SE Khan Bogdo 24 VI 71 (KOZLOV leg., 1 ex.); E-Gobi aimak, 25 km WNW of lake Tenger-Nur 25 VI 1971 (KOZLOV leg., 1 ex.); E-Gobi aimak, G.-Nomt-Ula, 30 km SSE of lake Shokoj-Nur 26 VI 1971 (KERZHNER, EMELJANOV leg., 5 ex.); E-Gobi aimak, Agarut 27 VI 1971 (KERZHNER leg., 4 ex.); E-Gobi aimak, 50 km ENE ajn-Shanda 2 VII 1971 (EMELJANOV leg., 1 ex.); E-Gobi aimak, S shore of lake Tenger-Nur 5 VIII 1971 (KERZHNER leg., 13 ex. on *Atriplex sibirica* C.A.M.); all from M. Le; from M. Bu are the following paratypes: Mongolia, Bajanchongor aimak, Cagan Bogd Ul Tooroin bulag, 13 km O v. Grenzposten Cagan-bulag, 1500 m, Exp. Dr. Z. KASZAB 1967, Loc. Nr. 81, 25 VI 1967, 1 ♀; Mittelgobi aimak, Delgerchangaj Ul, 6 km S von Somon Delgerchangaj, 1650–1700 m, Exp. Dr. Z. KASZAB 1967, Loc. Nr. 786, 11 VI 1967, 1 ♂; Gobi Altaj aimak, Sargyn Gobi SO Ecke, 1100 m, Exp.

Dr. Z. KASZAB 1966, Loc. Nr. 567, 24 VI 1966, 1 ♂; Bajanchongor aimak, Oase Echin gol, 90 km NO von Grenzposten Cagan bulag, 950 m, Exp. Dr. Z. KASZAB 1967, Loc. Nr. 855, 27–28 VI 1967, 1 ♀; Südgobi aimak, 100 km W v. Grenzposten Ovot Chuural, 1250 m, Exp. Dr. Z. KASZAB 1967, Loc. Nr. 835, 23 V 1967, 1 ♂. Holotype, paratypes in M. Le, paratypes as indicated in M. Bu, and in the collection of the authors.

Discussion. – The macropterous form of this rather large species looks at a first glance like *P. salsolae*, having similar color pattern and the wide metasternum. The latter differs however by a longer pronotum, narrow marginal laminae with only one row of areolae, longer juga and longer third antennal segment. It might also be confounded with the macropterous form of *P. kolenatii atriplicis* which has also marginal laminae with two rows of areolae, similar color patterns, pronotal carinae and juga; however, *P. kerzhneri* n. sp. can be separated by its generally larger size, wider pronotum which is only feebly impressed anteriorly, seen in profile (see figs. 40 b, d), longer third antennal segment and the remarkably wide metasternum. The small submacropterous forms, which have been collected together with the macropterous specimens, very much resemble the respective forms of *P. kolenatii atriplicis* and are difficult to separate. The Chinese *P. bificeps* also has a wide metasternum and broad marginal laminae, but is larger, has 2–3 rows of areolae and a very long third antennal segment, being 2 times as long as the fourth segment.

It is a pleasure to dedicate this species to our friend I. M. KERZHNER, who has collected most of the material and kindly made it available for our studies.

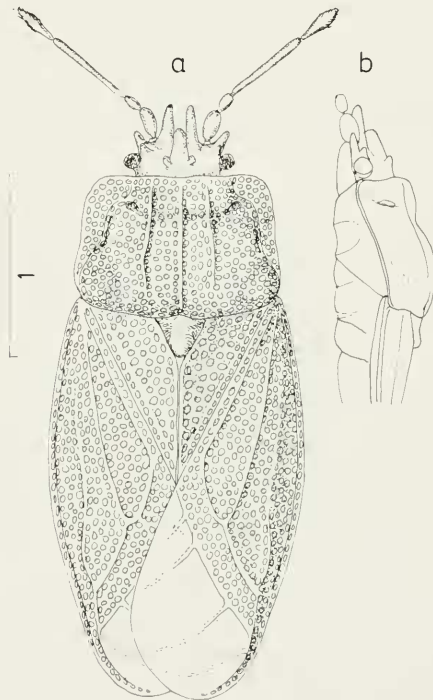


Fig. 41: a, b, *Piesma bificeps*. – a, dorsal view (Holotype ♀); b, id., lateral view. – Scale in mm. – (after HSIAO et JING, 1979 and HSIAO et al. 1981).

13. *Pisma (Parapiesma) bificeps* HSIAO et JING, 1979

*bificeps* (erroneously also *bificens*) HSIAO et JING, 1979: 457, fig. 13, holotype (♀, Peking, Si-San) NUT.

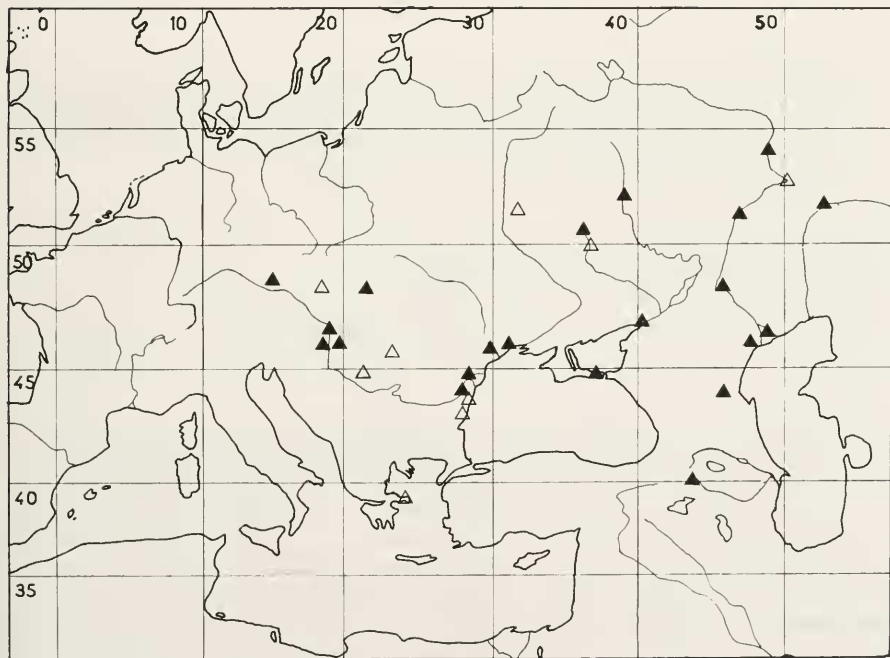
HSIAO et al. 1981: 221 et. figs. 683–685, table 27 photo 281.

Unknown to the authors, therefore the original description is followed.

Adult ♀. – General shape: fig. 41 a. Macropterous. Head yellowish brown, clypeus dark brown, granulate, two prominent tubercles at the base of the clypeus. Juga parallel, straight, projecting far beyond apex of clypeus. Preocular tubercles double, the anterior one 2.5 times as long as the posterior one. Pronotum 1.38 times as wide as its medial length, yellowish brown, the elevated posterior half mostly darker; with three distinct carinae, an additional one is slightly developed on each side laterally, the median one reaching from the anterior to the posterior margin. Marginal laminae wide, with 2–3 rows of areolae; lateral margins nearly parallel, slightly sinuate at middle; antero-lateral angles rounded, anterior margin straight. Scutellum brown at base with whitish tip. Hemelytra yellowish brown, veins and costal laminae without darker spots. Metasternum as wide as the diameter of hind coxae, apex truncate.

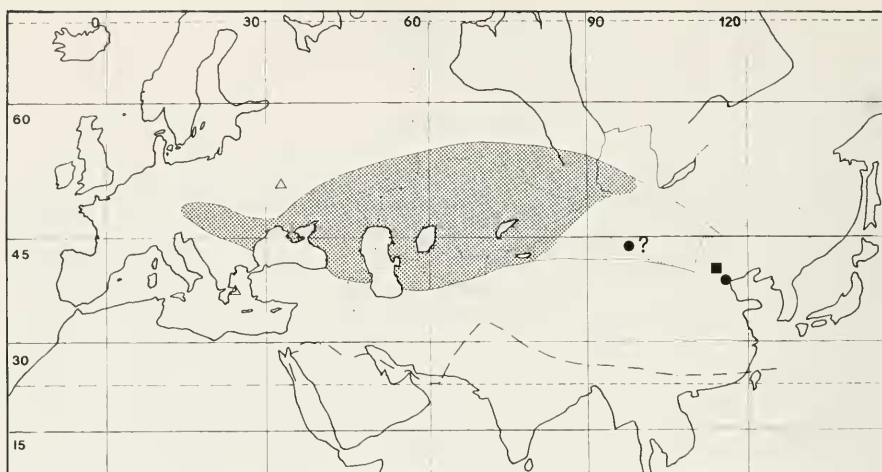
Length: 3.27 mm; antennal segments I:II:III:IV = 0.17:0.11:0.50:0.24 mm; head 0.37 mm.

Width: across hemelytra 1.43 mm; diatone 0.59 mm; anterior margin of pronotum 1.03 mm, maximum width 1.16 mm.



Map 11: Distribution of *Pisma kochiae kochiae* in the Western Palearctic Region.





Map 12: Palaearctic distribution of *Piesma kochiae* and *P. bificeps*. – The dotted area and triangles indicate the western ssp. *kochiae*; circles the eastern ssp. *longicarinum*. The type locality of *P. bificeps* is shown with a square.

Ecology. – Not indicated in the original description.

Distribution (Map 12). – To date, only the holotype is known which has been collected in the environments of Peking.

*Piesma bificeps* seems to be related to *P. quadratum* by the subrectangular pronotum, but it differs by sinuate, not straight lateral margins, straight, not contiguous juga and a wider metasternum. The shape of juga and metasternum resemble *P. variabile*, but this species has narrow marginal laminae with only one row of areolae and not 2–3 as *P. bificeps*. Only further material can reveal the true affinities.

#### 14. *Piesma* (*Parapiesma*) *josifovi* PÉRICART, 1977

*josifovi* PÉRICART, 1977: 33, holotype (♂, brach., Korea) M. So!

LEE & PARK 1971: 11 (*Piesma* sp. B); HSIAO et JING 1979: 459; HSIAO et al 1981: 220; HEISS et LEE 1983.

Adults. – General shape: figs. 42a, j. Brachypterous, rarely macropterous. Body surface yellowish-brown or greyish-brown, often with darker spots. Preocular tubercles double. Juga of males parallel or converging anteriorly, slightly darkened apically, surpassing the clypeus by 1.1 times the length of the eye; those of females shorter, 0.75 times the length of the eye (fig. 42b). Antennae stramineous, very slender, mostly darkened apically, the third segment 0.62–0.66 times as long as the diatone and about 1.5 times as long as the fourth segment. Rostrum reaches middle of procoxae. Pronotum 1.5–1.6 times as wide as its median length in brach. form, 1.32–1.35 times in macr. form; only slightly convex (brach.) or with posterior half elevated (macr.), with three prominent carinae extending to the posterior margin. A short ridge marks the humeri in brachypterous

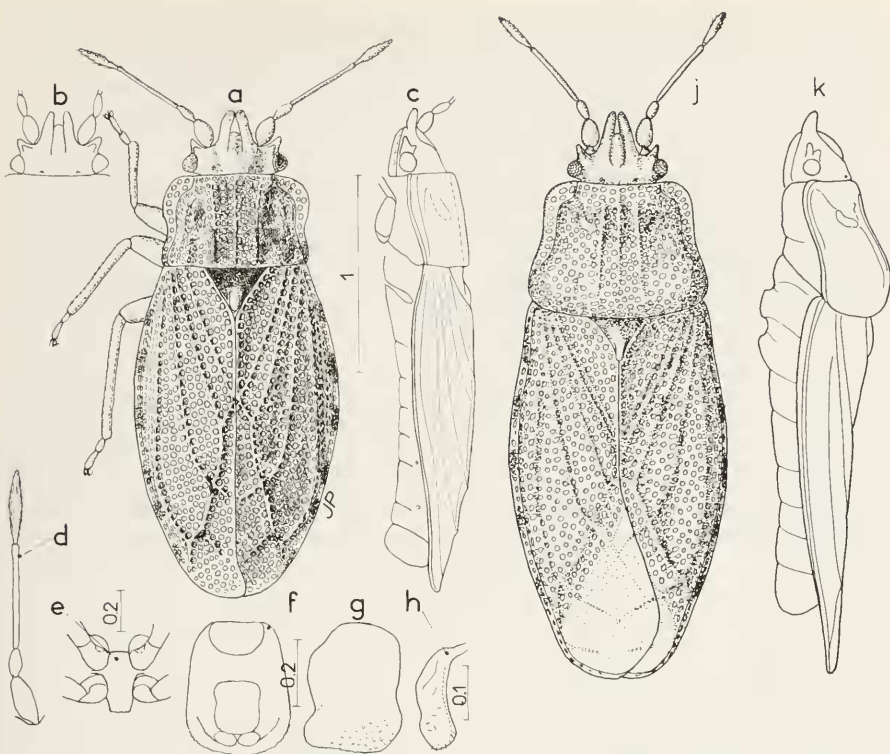


Fig. 42: *Piesma josifovi*. - a, ♂ (holotype: Korea); b, head of ♀ (allotype); c, lateral view; d, ♂, antenna; e, metasternum; f, g, pygophore; h, paramere; j, ♂, macropterous; k, lateral view of same specimen. - Scale in mm. - (a-h, after PÉRICART, 1977; j, k, after HEISS & LEE, 1983).

specimens. Marginal laminae rather large, uniseriate with some additional areolae anteriorly, lateral margin sinuate at middle. Hemelytra 1.3–1.6 times as long as their maximum width, distinctly enlarging from the basis to middle, completely areolate and without membrane (brach.) or with membrane (macr.); in brachypterous form only slightly surpassing the apex of the abdomen, overlapping along the suture posteriorly, veins prominent.

Metasternum very narrow (fig. 42e). Male pygophore: figs. 42f, g; parameres: fig. 42h.

Length: Male 2.4–2.6 mm (brach.), 2.9 mm (macr.), female 2.6–2.9 mm (brach.), 3.2 mm (macr.); antennal segments I:II:III:IV = 0.16:0.10:0.30–0.33:0.22 mm; rostral segments I:II:III:IV = 0.11:0.11:0.07:0.19 mm.

Width across hemelytra: male 1.10–1.20 mm, female 1.25–1.30 mm (brach.), 1.37 mm (macr.).

The brachypterous form of this species differs from all other Palaearctic species (except brach. *kochiae*) by its only slightly convex pronotum seen in profile, the shape of hemelytra and metasternum; from *kochiae* by its pronotal carinae as well as the humeral short ridges less prominent; the macropterous form by its characteristic, medially constricted shape in combination with narrow metasternum.

Egg (fig. 10 m). – According to LEE & PARK, 1971. Cucumber-shaped, slightly curved. Chorion and pseudopericulum covered with pestle-shaped tubercles, chorion with six longitudinal carinae; pseudopericulum with 4–6 micropylar processes which are also covered with tubercles. Length: 0.65 mm; diameter: 0.24 mm.

Fifth instar nymph. – According to LEE & PARK, l. c. General shape: fig. 43 a. Ob-long-ovate. Body surface finely reticulate but without granulation. Jugs slightly surpassing the clypeus. Antennae 1.1 times as long as the basal width of pronotum, relative length of antennal segments I:II:III:IV = 4:2.7:7:7.3; marginal laminae distinctly delimited. A tubercle is present on each tergite I to VIII medially and a smaller one on the metasternum. Latero-posterior angles of each urite, particularly V to VIII, strongly protruding. Length: 2.08 mm; width: diatone 0.52 mm, abdomen 1.06 mm.

Ecology and Distribution (Map 10). – This *Piesma* lives on *Chenopodiaceae*. Its host plant in South Korea is recorded as *Chenopodium acuminatum* WILLD. and *Ch. album* L. (PARK & LEE, 1975). In Mongolia, the adults have been collected beneath *Kochia* sp. and *Artemisia* sp. (KERZHNER, pers. comm.). Under the climatic conditions given in South Korea, the end of hibernation was observed at the beginning of April and the adults remain active to the beginning of December. About eight days after the adults had developed, the first oviposition took place; the eggs were laid on leaves, stems and buds of the

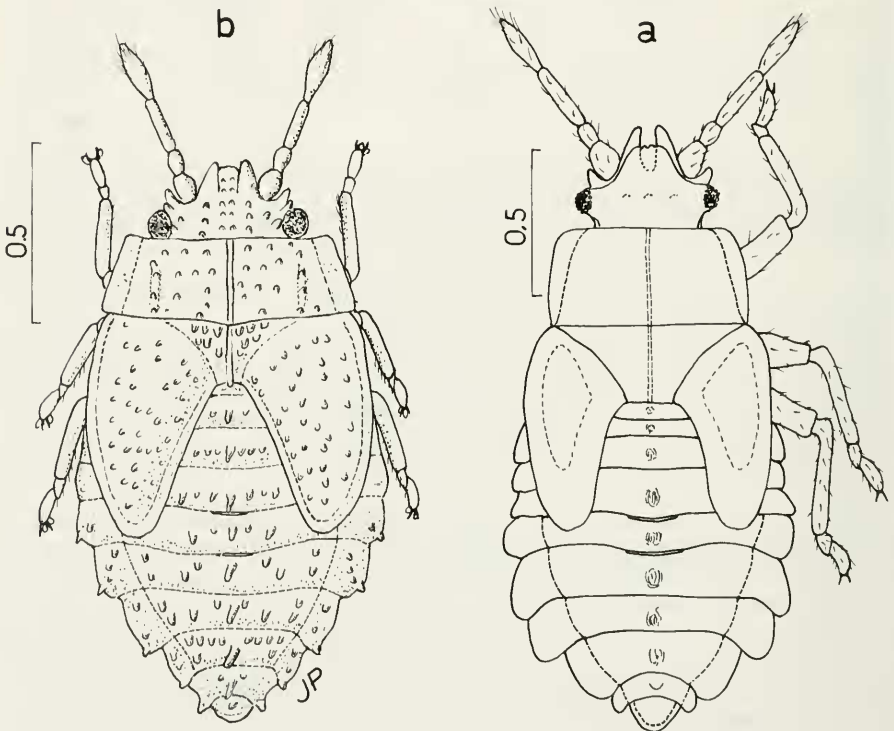


Fig. 43: a, *Piesma josifovi*, nymphal instar V; b, *P. kochiae*, nymphal instar V (Siberia: Omsk). – Scale in mm. – (a, after LEE & PARK, 1971; b, Original).

host plant. The complete development from egg to adult takes about one month; the first nymphal instars emerge after about 10 days. The actual number of generations is not indicated in the publication mentioned above. Hibernates as adults.

*Piesma josifovi* has been found in Mongolia, North China, Korea and the Russian Far East (Province of Vladivostok).

Mongolia. Border of Gobi Desert and Altai Mts., Ikhe Bogda (KERZHNER leg. M. Le!), Südgobi aimak VI 1964 (KASZAB leg. M. Bu!). – China. Peking, Pei-hai, 27 VI 1935 (ZHENZHURIST leg. M. Le!); Peking, RUBUOV 21 IX 1952 (M. Le!); Peking, Tianjin (HSIAO et JING 1979); Manchuria, Yanji 2 ex. VII 1939 (AKIZUKI leg. NSM!); – North Korea. Rjongaksan, 12 km W of Pjöngyang, 10 VII 1974, 5 ex. (JOSIFOV leg.), id., 30 V 1975, 23 ex.: type series. – South Korea. Env. of Taegu, IX 1960, VIII 1961, brach. and macr.!; Kosan near Taegu, X 1958!, Shincheondong near Taegu, VIII 1961! (all LEE leg. et coll.). – Russian far east. Vladivostok, 1 ex. (M. Le!).

## 15. *Piesma (Parapiesma) kochiae* (BECKER, 1867)

### 15a. *Piesma kochiae kochiae* (BECKER)

*kochiae* BECKER, 1867: 113 (*Zosmenus*) lectotype (♀, brach., Lower Volga) M. Le!; – *fieberti* JAKOVLEV, 1874b: 27 (*Zosmenus*) lectotype (♀, macr., Astrachan) M. Le!; – *porcatus* HORVÁTH, 1874: 332 (*Zosmenus*) type? (Hungary).

HORVÁTH 1906: 9; KIRITSHENKO 1951: 238; STICHEL 1957: 41; PUTSHKOV 1974: 70; HEISS & PÉRICART 1975: 534 (lectotypes).

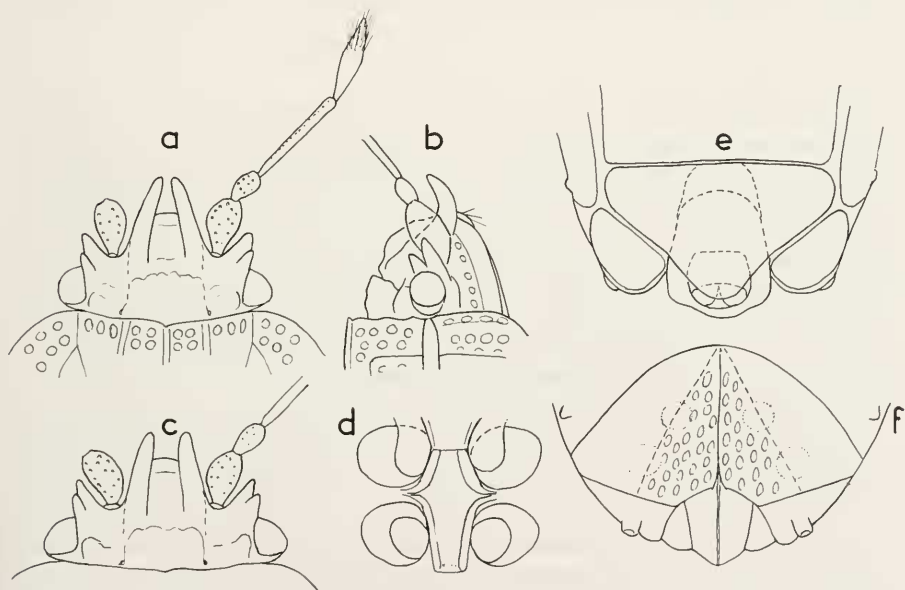


Fig. 44: *Piesma kochiae*. – a, ♂, head, dorsal view, (Southern Russia); b, id., lateral view; c, ♀, head, dorsal view; d, metasternum; e, ♂, terminal segments, dorsal view; f, ♀, terminal segments, ventral view. – (Original).

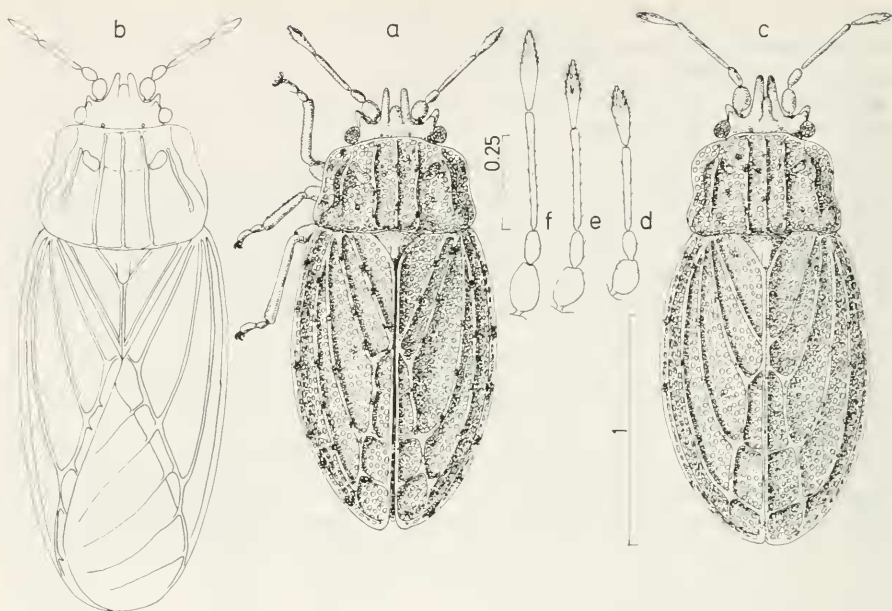


Fig. 45: a, b, d, *Piesma kochiae*. - a, ♂, brachypterous (Hungary); b, ♀, macropterous (lectotype of *fieberi*: Southern Russia); d, right antenna. - c, e, *P. kochiae* ssp. *longicarinum*. - c, ♂, dorsal view. - (paratype); e, id., right antenna. - f. *P. josifovi*, right antenna. - Scale in mm. - (Original).

Adults. - General shape: macr. fig. 45 b, brach. fig. 45 a. Brachypterous or rarely macropterous. General color brownish-grey or greenish, pronotal carinae and hemelytral veins with brownish spots. Head: figs. 44 a, b, c; preocular tubercles double; juga of males narrow, subparallel, surpassing the clypeus by about 1.0 times the length of the eye; those of females on an average shorter; clypeus convex posteriorly, delimited by the frons. Antennae pale except the fourth segment which is darkened; third segment 0.45-0.53 times as long as the diatone and 1.20-1.40 times as long as the fourth segment (fig. 45 d). Rostrum surpassing the procoxae, often reaching middle of mesosternum. Pronotum of macropterous forms 1.5 times as wide as its median length; with five prominent longitudinal carinae, the three median ones reaching the posterior margin of pronotum, the two lateral ones present only on median  $\frac{1}{3}$ .

Marginal laminae developed, bearing one complete row of areolae and a second incomplete one anteriorly; lateral margins converging anteriorly, distinctly sinuate at middle. Pronotum of brachypterous forms subrectangular, only slightly convex seen in profile, 1.4-1.8 times as wide as its median length, carinae as in macropterous forms. Hemelytra 1.8 times (macr.) or 1.1-1.5 times (brach.) as long as their maximum width; main veins carinate, prominent; membrane in macr. completely developed, in brach. absent with contiguous suture, rounded apically, clavus not delimited. Metasternum narrow, elongate (fig. 44 d). Male genital segments: fig. 44 e; paramers figs. 39 q, r. Female genital segments: fig. 44 f.



Length: macr. 2.3–2.75 mm; brach. 1.5–2.1 mm (males), 1.8–2.4 mm (females); antennal segments I+II:III:IV = 0.18–0.22: 0.22–0.26:0.17–0.22 mm; rostral segments I:II:III:IV = 0.11:0.10:0.07:0.19 mm.

Width: across hemelytra 0.90–1.25 mm.

This *Piesma* is easy to be identified among the Palaearctic species and resembles *P. cecramicum* McATEE from North America.

Egg (figs. 10g, h). – Referring to PUTSHKOV, 1974. Yellowish, sometimes reddish, robust and slightly curved. Chorion covered with pestleshaped tubercles and several longitudinal ridges. Pseudopericulum with 4–5 micropylar processes, which are finger-shaped and arranged like a crown. These processes are covered with tubercles. Length 0.53 mm, diameter 0.22 mm.

Fifth instar nymph (fig. 43b). – Referring to our observations on specimens from Russia. Ovate, greenish with paler parts; body surface covered with small spiniform tubercles arranged in transversal rows, rather prominent on the visible tergites, with the most prominent tubercle medially. Juga slightly surpassing the clypeus (fig. 9h). Antennae  $\frac{2}{3}$  as long as the basal width of pronotum, relative length of segments I:II:III:IV = 3.5:3:5:6.5. Pronotum short, three times as wide as its median length; marginal laminae delimited. Lateral margins of abdomen denticulate, posterolateral angles of the last three segments pointed, prominent. Length: 1.30–1.60 mm; width of abdomen 0.80 mm.

Ecology. – The development of this species has been studied by PUTSHKOV. In Southern Russia it feeds on *Chenopodiaceae* of the genus *Kochia*; *K. laniflora* (GMEL.) BORB. (= *arenaria* [MAERKLIN] ROTH.), on alluvial sands, clearings and marginal areas of forests; on *K. prostrata* (L.) SCHRAD. mainly on the saline soils of the coasts of the Black Sea and the Sea of Azov as well as in the deserts and on the hills of Krym. From Hungary it is mentioned to live on *Kochia laniflora* by HORVATH (1906) and from Kazakhstan on *Echinopsilon* sp.

WAGNER (1966) indicated *Eurotia ceratoides* C. A. MEY. as host plant, but PUTSHKOV reported that *P. kochiae* was attracted by these plants neither in the Ukraine nor in Central Asia.

This *Piesma* hibernates as an adult near the host plants, beneath clusters of grass or in the sand 2–3 cm under the surface. At the end of April and the beginning of May, when young buds of *Kochia* appear, the adults first feed and then mate. Oviposition starts about the middle of May and eggs are deposited on the soil, near fresh buds, or on the living branches of *Kochia*.

Embryonic development takes about one week; eclosion of first instar has been observed at the end of May and hatching extends to July, when the adults of the new generation appear. In the second half of August most of the populations are adult, but in October some nymphs can still be found.

JAKOVLEV (1874b) has observed dense populations of adults and nymphs, aggregated on the host plants like aphids.

Distribution (Maps 11, 12). – *Piesma kochiae* is characteristic of Eurasiatic steppes. In Europe it shows a pannonian distribution from eastern parts of Austria to the Black Sea; it occurs in most parts of Southern Russia and from there eastward crossing Kazakhstan, the southern part of Siberia and Russian Central Asia, it extends as far as Mongolia and probably to North China.

Austria. Lower Austria: Jetzelsdorf, numerous (coll. WAGNER!; FRANZ & WAGNER 1961). – Czechoslovakia. Slovakia (HOBERLANDT 1977). – Hungary. (type of *porcatum*). Central plain, spread: Budapest and env.!, Kécskemét!, Dunaföldvár!, Székesfehérvár (HORVÁTH 1897), Tarczal (div. coll.!), Tokaj (HORVÁTH, l. c.). – Romania. Transylvania: Grădiştea (SIENKIEWICZ 1964); Dobrouja: Măcin (MONTANDON leg. > M. Bc!), Mangalia (HORVÁTH 1906), Hirsova (MONTANDON leg. > BM!). – Yugoslavia. Vojvodina: Deliblat (HORVÁTH 1897). – Bulgaria. Env. of Varna, 24 VIII 1961 (ŠTYS leg. et coll.; JOSIFOV 1964). – Greece. Attica (EMGE leg.; REUTER 1891). – European USSR. Steppic region, going north to Cherni-Belgorod, Voronezh!, Saratov!, and Kuybychev; reaching south to the Black Sea, Sea of Azov, North Caucasus, republics of Ciscaucasia (PUTSHKOV 1974). Odessa!, Kertsh!, Rostov!, Volgograd!, Astrakhan! (types of *feberi*), Kizljär!. – Transcaucasia. Armenia (M. Le!). – Kazakhstan. Northwest: Janvartsevo, banks of river Ural (M. Le!); Central: Karaganda (M. Le!); South: Alma-Ata (id.!). – Uzbekistan, Turkmenistan and Kirghizia (sec. PUTSHKOV 1974). – Tadzhikistan. Tien-Shan Mts. (POPOV 1965). – Southern Siberia: Omsk (PUTSHKOV, l. c.); upper course of river Jenissei, Abakan (M. Le!); Tuviniskaya ASSR; Kyzyl, 13 VIII 1964 (KERZHNER leg. > M. Le!). – Mongolia. Southwest: hills of Ikhe-Bogdo at the border of Gobi desert and Altai Mts., 17 VIII 1926 (KIRITSHENKO leg. > M. Le!), is probably ssp. *longicarinum*.

**15b. *Piesma kochiae* ssp. *longicarinum* HSIAO et JING, nov. stat.**

*longicarina* HSIAO et JING, 1979: 457, fig. 12, holotype ♂ and allotype ♀ (Tianjin) NUT, paratypes ♂♀!

HSIAO et al. 1981: 220 et figs. 677–679, table 27, photo 280.

Adults. – General shape and color pattern as the nominal species but usually larger and more slender (fig. 45c). Only brachypterous specimens known. Juga of males long, surpassing clypeus about 1.2 times the length of the eye, subparallel, leaving only a narrow cleft between them; shorter in females. Antennae slender, slightly longer than the maximum width of pronotum and 1.50–1.56 times as long as the diatone; third segment 0.6–0.65 times as long as the diatone (fig. 45e). Pronotum with rounded anterolateral angles, lateral margins more sinuate at middle than *P. kochiae kochiae*.

Length: brach. 2.17–2.66 mm; antennal segments I:II:III:IV = 0.13:0.08:0.27:0.19 mm.

Width: across hemelytra 0.92–1.1 mm.

*P. longicarinum* has been described as a distinct species, but shares all essential characters of *P. kochiae*. However it also shows some morphological differences by which it can be separated from the nominal species and is therefore regarded as a subspecies. *P. kochiae longicarinum* is generally larger and more slender, and its antennae are considerably longer, particularly the third segment. The juga of males are more contiguous at apex and the lateral margins of the pronotum are more sinuate at the middle.

The habitually similar brachypterous form of *P. josifovi* has even longer antennae, a more laterally constricted pronotum with only three carinae and a pyriform abdomen.

Ecology. – Not mentioned in the description; most probably it also feeds on *Chenopodiaceae*.

Distribution (Map 12). – The type series is from Tianjin (Tientsin) and env. Peking.

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#### IV. Abbreviations used for Museums and Institutions

BM	British Museum, Natural History, London
EGU	Ege Üniversitesi, Ziraat Fakültesi, Izmir-Bornova, Turkey
IEM	Instituto Español de Entomología, Madrid, Spain
M. Am	Institut voor Taxonomische Zoölogie (Zoölogisch Museum), Universiteit van Amsterdam, Netherlands
M. Bc	Musée d'Histoire Naturelle „Grigore ANTIPA“, Bucarest, Romania
M. Be	Museum für Naturkunde der Humboldt-Universität zu Berlin, German Democratic Republic
M. Bo	Istituto di Entomologia dell'Università di Bologna, Italy
M. Bu	Természettudományi Múzeum Állatára, Budapest, Hungary
M. Ge	Museo Civico di Storia Naturale „Giacomo DORIA“, Genoa, Italy
M. Gev	Museum d'Histoire Naturelle de la Ville de Genève, Switzerland
M. He	Universitets Zoologiska Museum, Entomologiska Avdelningen, Helsinki, Finland
M. Hg	Zoologisches Museum der Universität Hamburg, Federal Republic of Germany
M. Ld	Rijksmuseum van Natuurlijke Historie, Leyden, Netherlands
M. Le	Zoological Institute, Academy of Sciences, Leningrad, USSR
M. Lu	Zoological Institute, Department of Entomology, University of Lund, Sweden
M. Ly	Musée d'Histoire Naturelle de la Ville de Lyon, France (Musée Guimet)
M. Mu	Zoologische Sammlung des Bayerischen Staates, Munich, Bavaria, FRG
M. Pa	Muséum national d'Histoire naturelle, Laboratoire d'Entomologie Générale et Appliquée, Paris, France
M. So	Zoological Institute and Museum, Bulgarian Academy of Sciences, Sofia, Bulgaria
M. Vi	Naturhistorisches Museum, Zoologische Abteilung, Vienna, Austria
NHMT	Natural History Museum Tianjin, P. R. of China
NSM	National Science Museum, Tokyo, Japan
NUT	Nankai University Tianjin, P. R. of China
UMd	Universidad Complutense, Facultad de Biología, Madrid, Spain
USNM	United States National Museum, Smithsonian Institution, Washington, D.C., U.S.A.

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- Symphytum* sp. – *Piesma kolenatii kolenatii* 141  
*Tetragonia* sp. – *Piesma quadratum* 111  
*Tblaspi* sp. – *Piesma quadratum* 111  
*Tuberaria guttata* (L.) FOURR. (= *Helianthemum guttatum* MILL.) – *Piesma variabile*  
123  
(*Tunica saxifraga*): Cf *Petrorhagia saxifraga*  
*Verbascum* sp. – *Piesma capitatum* 101, *Piesma maculatum* 104

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